Release Note

Software Release 2.6.1

For AT-8900 Series Switches

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Introduction

Allied Telesyn announces the release of Software Release 2.6.1 for the AT-8900 Series switches. The AT-8900 Series Switches are a new series of high-end Layer 3+ switches built to meet the needs of high performance network services.

The AT-8900 Series Switches are currently represented by the AT-8948 Multi-layer Fast Ethernet Switch.

The files included in this software release are shown in the table below.

Table 1: File names for Software Release 2.6.1 on AT-8948 Switches.

Software release file	89-261.rez
CLI help file	89-261A.HLP

This release note describes the following aspects of the 2.6.1 release:

- key hardware features of the AT-8948 switch
- significant new software features that have been implemented in Software Release 2.6.1 to support the AT-8900 Series switches

You should read this release note in conjunction with following documentation for the AT-8948 switch:

- Hardware Reference
- Software Reference
- Quick Install Guide
- Quick Install Guide for the power supply unit (PSU)
- Safety Booklet

These documents are on the Documentation and Tools CD-ROM packaged with your switch, or you can download these documents from: *www.alliedtelesyn.co.nz/support/at8900*

WARNING: Information in this release note is subject to change without notice and does not represent a commitment on the part of Allied Telesyn International. While every effort has been made to ensure that the information contained within this document and the features and changes described are accurate, Allied Telesyn International can not accept any type of liability for errors in, or omissions arising from the use of this information.

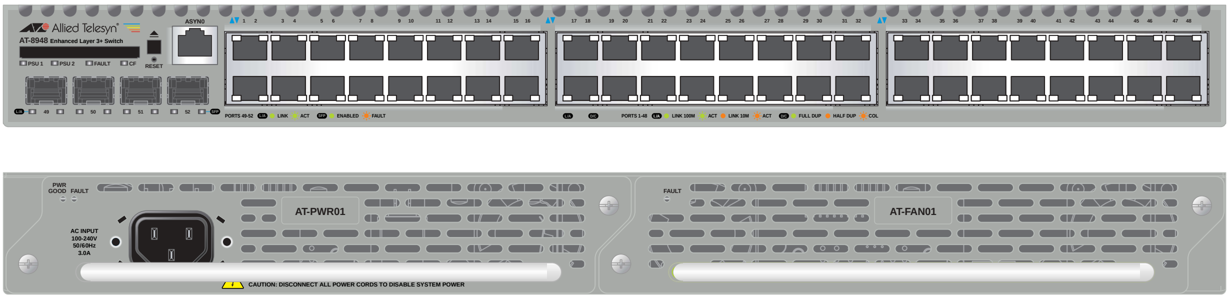
Key Hardware Features of the AT-8900 Series Switch

Key hardware features of the AT-8948 Multi-layer Fast Ethernet Switch are:

- 1RU form factor
- dual, hot-swappable, load-sharing power supply units (AC or DC options) accessible at the rear of the switch chassis
- front to back cooling
- 4 SFP (Small form-factor pluggable) 1000BASE-X uplink sockets accessible on the front panel
- 48 ports with 10/100BASE-T RJ-45 connectors accessible on the front panel
- 1 Compact Flash socket accessible on the front panel
- 1 DIMM socket for expansion of Synchronous DRAM

The front and rear panels of the AT-8948 switch are shown in Figure 1.

Figure 1: Front and rear panels of the AT-8948.


Allied Telesyn
AT-8948 Enhanced Layer 3+ Switch
PSU 1
PSU 2
FAULT
CF
RESET
ASYN0
PWR GOOD
FAULT
AC INPUT 100-240V 50/60Hz 3.0A
AT-PWR01
AT-FAN01
FAULT
CAUTION: DISCONNECT ALL POWER CORDS TO DISABLE SYSTEM POWER

The AT-8948 switch is supplied with one power supply unit and one fan only module installed as standard. To order additional power supply units, contact your authorised Allied Telesyn distributor or reseller for more information, or visit: www.alliedtelesyn.co.nz/support/at8900

Power Supply Units (PSUs)

The following important information applies to the AT-PWR01 power supply units (AC only):

- CAUTION: double pole/neutral fusing
- The ratings of fuses FH101 and FH102 is 250 V, 5 A

This information was incorrectly omitted from the *AT-8900 Series Hardware Reference* for Software Release 2.6.1.

PSU LEDs on AT-8900 Switches

When a PSU bay on the switch is empty, i.e no PSU or fan only module (FOM) is installed, the LED for that PSU bay is lit red.

This was incorrectly specified as not lit in the *AT-8900 Series Hardware Reference, AT-8900 Series Quick Install Guide,* and *AT-PWR01 Quick Install Guide* for Software Release 2.6.1

SFP Transceivers

An additional SFP transceiver has been approved for use with AT-8900 Series switches:

- AT-MG8LX10 10km LX SFP

This information was incorrectly omitted from the *AT-8900 Series Hardware Reference* for Software Release 2.6.1.

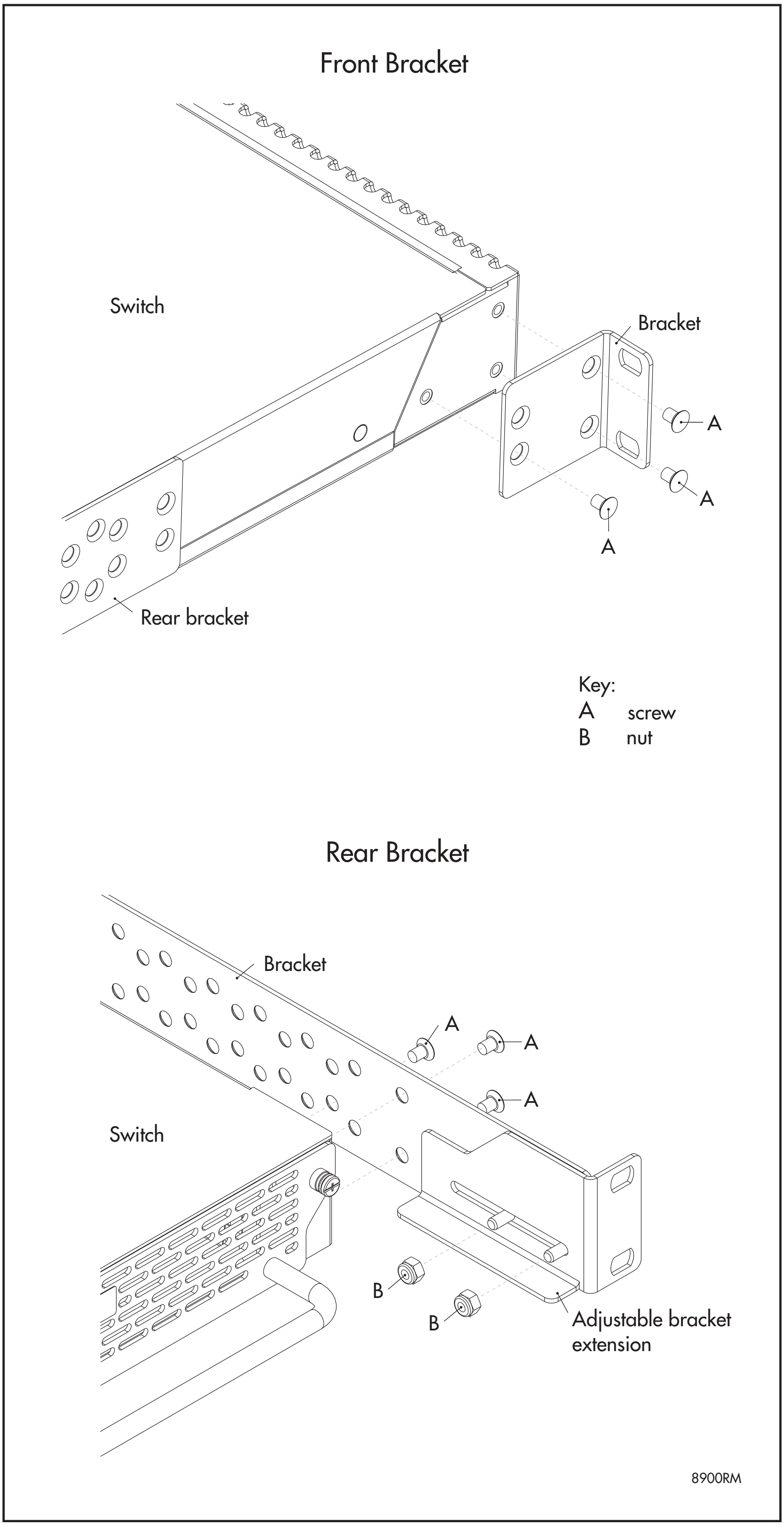
Installing the Switch Using the Rack-mount Kit

A 19 inch rack-mount kit is supplied with the AT-8948 switch. To install the switch using the rack-mount kit:

1. Ensure the rack has sufficient space for the switch and its associated cables.
2. Remove the rubber feet from the switch.
3. Screw the brackets to the sides of the switch using the supplied M4 screws (see Figure 2).
4. Fit the adjustable bracket extension onto the rear bracket but do not fully tighten the nuts. You may need to adjust the position of the extension bracket to correctly fit the switch into the rack (see Figure 2).
5. Mount the switch in the rack using appropriate rack mounting screws (not supplied).

This information was incorrectly omitted from the *AT-8900 Quick Install Guide* for Software Release 2.6.1.

Figure 2: Fitting rack-mount brackets on the switch



Packet Classifier

The Generic Packet Classifier, or Classifier, performs packet classification. The Classifier defines packet matching rules that classify packets into *data flows*. A data flow is a categorisation of packets that obey a predefined rule and are processed in a similar manner.

After you have defined the packet matching rules in the Classifier, other software features are used to specify what action is taken on a packet that matches the rule.

You must create an association between the rule in the Classifier and an action elsewhere. See "*Quality of Service (QoS)*" on page 10 and "*Classifier-Based Packet Filters*" on page 42.

Configuration of Packet Matching Rules/Classifiers

You can create a set of packet matching rules, or classifiers. These classifiers can identify any single packet based upon the following criteria:

- Ethernet encapsulation type
  Packets are classified depending on the specific protocol type of each frame. Different values indicate how the packet is formatted. For example, a value of 802.2 indicates the packet is formatted according to IEEE standards 802.2 and 802.3 with a Destination Service Access Point/Source Service Access Point (DSAP/SSAP) value not equal to AAAA in hexadecimal; SAP encapsulation. A value of ETHII indicates the packet is formatted according to RFC 894; Ethernet II encapsulation.
- Source/Destination MAC address
  All frames from a specific source or destination MAC address are classified to the same VLAN and/or priority. This classification can be used for users on remote networks.
- Layer 3 protocols
  Frames are classified based on any value for Layer 3 protocols. The silicon can match on all IP or IPX packets irrespective of the exact type of Ethernet encapsulation. Layer 3 protocol and Ethernet encapsulation types are interrelated, e.g. IPX Ethernet II encapsulated packets are different to IPX NETWARERAW encapsulated packets.
- Source/destination IP address
  Frames are classified based on an exact match of the source or destination IP address information within the IP header of each frame.
- Destination IPX address
  Frames are classified based on specific information contained within the header of an IPX frame.
- Layer 4 protocol (TCP/UDP, etc.)
  Frames are classified based on specific Layer 4 TCP or UDP destination and source port numbers contained within the header of an IP frame.
- Layer 4 source/destination port
  Frames are classified based on a specific port number or a range of port numbers.
- Source VLAN
  Frames are classified based on the unique name of the source destination VLAN.

Configure Classifiers

To create a classifier, use the command:

```
CREATE CLASSIFIER=rule-id [MACDADDR={macadd|ANY}]
   [MACSADDR={macadd|ANY}] [MACTYPE={L2UCAST|L2MCAST|
   L2BCAST|ANY}] [VLAN={vlan-name|1..4094|ANY}]
   [ETHFORMAT={802.2-TAGGED|802.2-UNTAGGED|ETHII-TAGGED|
   ETHII-UNTAGGED|NETWARERAW-TAGGED|NETWARERAW-UNTAGGED|
   SNAP-TAGGED|SNAP-UNTAGGED|ANY}] [PROTOCOL={protocoltype|
   ANY}] [IPDADDR={ipaddmask|ANY}] [IPSADDR={ipaddmask|ANY}]
   [IPDSCP={dscplist|ANY}] [IPPROTOCOL={TCP|UDP|ICMP|IGMP|
   ipprotocolnum|ANY|NONTCPUDP}] [IPTOS={0..7|ANY}]
   [IPXDADDR={ipxadd|ANY}] [IPXDSOCKET={NCP|SAP|RIP|NNB|
   DIAG|NLSP|IPXWAN| ipxsocketnum|ANY}] [IPXSSOCKET={NCP|SAP|
   RIP|NNB|DIAG|NLSP|IPXWAN|ipxsocketnum|ANY}]
   [TCPDPORT={portid|ANY}] [TCPSPORT={portid|ANY}]
   [UDPDPORT={portid|ANY}] [UDPSPORT={portid|ANY}]
```

To modify a classifier, use the command:

```
SET CLASSIFIER=rule-id [MACDADDR={macadd|ANY}]
   [MACSADDR={macadd|ANY}] [MACTYPE={L2UCAST|L2MCAST|
   L2BCAST|ANY}] [VLAN={vlan-name|1..4094|ANY}]
   [ETHFORMAT={802.2-TAGGED|802.2-UNTAGGED|ETHII-TAGGED|
   ETHII-UNTAGGED|NETWARERAW-TAGGED|NETWARERAW-UNTAGGED|
   SNAP-TAGGED|SNAP-UNTAGGED|ANY}] [PROTOCOL={protocoltype|
   ANY}] [IPDADDR={ipaddmask|ANY}] [IPSADDR={ipaddmask|ANY}]
   [IPDSCP={dscplist|ANY}] [IPPROTOCOL={TCP|UDP|ICMP|IGMP|
   ipprotocolnum|ANY|NONTCPUDP}] [IPTOS={0..7|ANY}]
   [IPXDADDR={ipxadd|ANY}] [IPXDSOCKET={NCP|SAP|RIP|NNB|
   DIAG|NLSP|IPXWAN| ipxsocketnum|ANY}] [IPXSSOCKET={NCP|SAP|
   RIP|NNB|DIAG|NLSP|IPXWAN|ipxsocketnum|ANY}]
   [TCPDPORT={portid|ANY}] [TCPSPORT={portid|ANY}]
   [UDPDPORT={portid|ANY}] [UDPSPORT={portid|ANY}]
```

Note that if an ETHFORMAT parameter option is specified, the option must include either TAGGED or UNTAGGED. For example, either ETHII-TAGGED or ETHII-UNTAGGED, NETWARERAW-TAGGED or NETWARERAW-UNTAGGED, etc.

The available ETHFORMAT and PROTOCOL parameter combinations and their implementation in the Classifier are shown Table 2.

Table 2: Available ETHFORMAT and PROTOCOL parameter combinations

ETHFORMAT=	PROTOCOL=	CLASSIFIER	ASIC Chip
ETHII	[not specified]	OK	Error
	ANY	OK	Error
	IP	OK (1)	Ok
	IPX	OK (2)	OK
	protocoltype	OK	OK
NETWARERAW	[not specified]	OK (3)	OK
	ANY	OK (3)	OK
	IP	Error	n/a
	IPX	OK (3)	OK
	“IPX 802.3”	OK	OK
	protocoltype	Error	n/a

Table 2: Available ETHFORMAT and PROTOCOL parameter combinations

ETHFORMAT=	PROTOCOL=	CLASSIFIER	ASIC Chip
SNAP	[not specified]	OK	Error
	ANY	OK	Error
	IP	OK	OK Protocol=xxxxxx0800
	IPX	OK	OK Protocol=xxxxxx8137
	protocoltype	OK	OK
802.2	[not specified]	OK	Error
	ANY	OK	Error
	IP	Error	n/a
	IPX	OK (4)	OK
	protocoltype	OK	OK

Key to table:

- [not specified] = the PROTOCOL parameter is not specified on the command line
- (1) = equivalent to specifying PROTOCOL=0800
- (2) = equivalent to specifying PROTOCOL=8137
- (3) = equivalent to specifying PROTOCOL="IPX 802.3"
- (4) = equivalent to specifying PROTOCOL=E0.

To display the output of the SHOW CLASSIFIER command and packet matching rules, use the command:

```
SHOW CLASSIFIER=rule-id [MACDADDR={macadd|ANY}]
    [MACSADDR={macadd|ANY}] [MACTYPE={L2UCAST|L2MCAST|
    L2BCAST|ANY}] [VLAN={vlan-name|1..4094|ANY}]
    [ETHFORMAT={802.2-TAGGED|802.2-UNTAGGED|ETHII-TAGGED|
    ETHII-UNTAGGED|NETWARERAW-TAGGED|NETWARERAW-UNTAGGED|
    SNAP-TAGGED|SNAP-UNTAGGED|ANY}] [PROTOCOL={protocoltype|
    ANY}] [IPDADDR={ipaddmask|ANY}] [IPSADDR={ipaddmask|ANY}]
    [IPDSCP={dscplist|ANY}] [IPPROTOCOL={TCP|UDP|ICMP|IGMP|
    ipprotocolnum|ANY|NONTCPUDP}] [IPTOS={0..7|ANY}]
    [IPXDADDR={ipxadd|ANY}] [IPXDSOCKET={NCP|SAP|RIP|NNB|
    DIAG|NLSP|IPXWAN| ipxsocketnum|ANY}] [IPXSSOCKET={NCP|SAP|
    RIP|NNB|DIAG|NLSP|IPXWAN|ipxsocketnum|ANY}]
    [TCPDPORT={portid|ANY}] [TCPSPORT={portid|ANY}]
    [UDPDPORT={portid|ANY}] [UDPSPORT={portid|ANY}]
```

For detailed information about how to configure classifiers, see the *Generic Packet Classifier* chapter of the *AT-8900 Series Software Reference*.

Quality of Service (QoS)

Quality of Service refers to the ability to intelligently manage network traffic to allow stable and predictable end-to-end network performance. QoS mechanisms enable:

- the prioritisation of network traffic
- the management of the bandwidth available to that traffic

On the AT-8948 switch, QoS controls are applied to traffic ingressing ports. Therefore, to control a particular type of traffic, an appropriate QoS policy must be attached to each port that type of traffic ingresses.

An Overview of the QoS Mechanisms on the Switch

QoS is a broadly used term that encompasses as a minimum both Layer 2 and Layer 3 in the OSI model.

Quality of Service is typically demonstrated by how the switch:

- assigns priority to incoming frames, if they do not carry priority information
- maps prioritised frames to traffic classes, or maps frames to traffic classes based upon other criteria
- maps traffic classes to egress queues, or maps prioritised frames to egress queues
- provides minimum and maximum bandwidth guarantees for traffic classes, egress queues, and/or ports
- schedules frames in egress queues for transmission (for example, empty queues in strict priority or sample each queue)
- relabels the priority of outgoing frames
- determines which frames to drop, remark or requeue if the network becomes congested
- determines which frames to drop if the network becomes congested
- reserves memory for switching/routing or QoS operation (e.g. reserving buffers for egress queues, or buffers to store packets with particular characteristics)

Packet Flow through the Switch

The flow of a packet through the switch's QoS engine are shown in Figure 3 on page 12 and Figure 4 on page 13. Figure 3 includes for reference the processing points at which the switch determines whether the packet is to be bridged (layer 2 switched) or routed (layer 3 switched). Each stage in the packet processing is numbered in Figure 3 and summarised in Table 3.

Table 3: Stages in the packet processing for QoS

Stage	Description	For more information
1	The packet arrives at the ingress port.	"Switch Ports", *Switching* chapter, *AT-8900 Series Software Reference.*
2	For tagged packets, the switch maps the packet's initial VLAN tag User Priority value to an egress queue. For untagged packets, the switch assigns the packet to the default queue.	"*How to Enable Layer 2 QoS Functionality on the switch*" on page 32
3	The switch determines whether the packet is to be bridged (layer 2 switched) or routed (layer 3 switched). If it is to be bridged, the switch determines what its destination port or ports will be.	"*The Layer 2 Switching Process*", *Switching* chapter, A*T-8900 Series Software Reference*.
4	The switch classifies the packet. Classification sorts traffic into data flows.	*Generic Packet Classifier* chapter, *AT-8900 Series Software Reference.*
5	If you configure *premarking*, the switch replaces one or both of the packet's initial DSCP or VLAN tag User Priority values, or assigns the packet to a bandwidth class or an egress queue.	"*Premarking*" on page 17
6	If you configure *metering*, the switch measures how much bandwidth the packet uses. From this, it determines whether or not the packet conforms to the bandwidth specifications of the data flow to which the packet belongs.	"*Bandwidth Metering*" on page 19
7	If you configure *remarking*, the switch remarks the packet as a result of the metering. Like premarking, remarking involves changing one or both of the packet's DSCP or VLAN tag User Priority values, or assigning the packet to a bandwidth class or an egress queue. If you configure dropping bandwidth class 3, the switch discards the packet if it does not conform to the bandwidth specifications of the data flow.	"*Remarking*" on page 22, and the DROPBWCLASS3 parameter of the CREATE QOS TRAFFICCLASS command, *Quality of Service* chapter*, AT-8900 Series Software Reference.*
8	The switch determines whether the packet is to be routed (layer 3 switched) and if so, what its destination port or ports will be.	*Internet Protocol (IP)* chapter*, AT-8900 Series Software Reference,* for information about IP.
9	The switch determines whether the appropriate egress queue has room for the packet. If the queue has room, the switch puts the packet in that queue. If the queue is congested, the switch may discard the packet instead, according to the default tail drop scheme or the configured RED curve or tail drop scheme. For a detailed diagram of this stage, see Figure 4 on page 13.	"*QoS RED Curves*" on page 24, "*Tail-drop discarding scheme*" on page 26, and the SET QOS PORT EGRESSQUEUE command, *Quality of Service* chapter, *AT-8900 Series Software Reference.*
10	The Egress Queue Scheduler empties the queues according to the default or configured scheme, at a rate that does not exceed the bandwidth available at the egress port. The packet leaves out the egress port. For a detailed diagram of this stage, see Figure 4 on page 13.	The SCHEDULER parameter of the SET QOS PORT EGRESSQUEUE command, *Quality of Service* chapter*, AT-8900 Series Software Reference.* The EGRESSLIMIT parameter of the SET SWITCH PORT command*, Switching* chapter*, AT-8900 Series Software Reference*.

Figure 3: Packet flow through the QoS engine

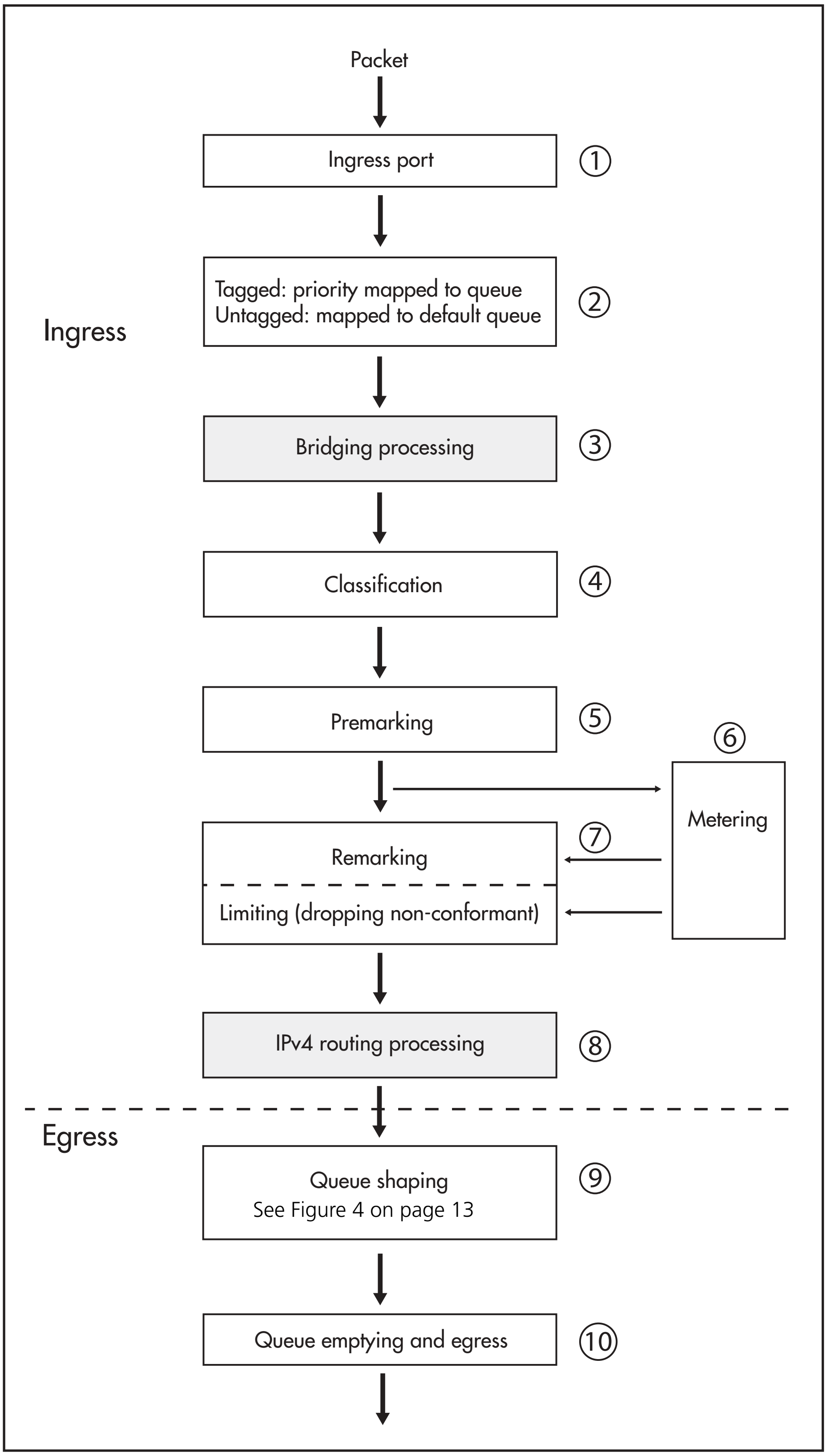
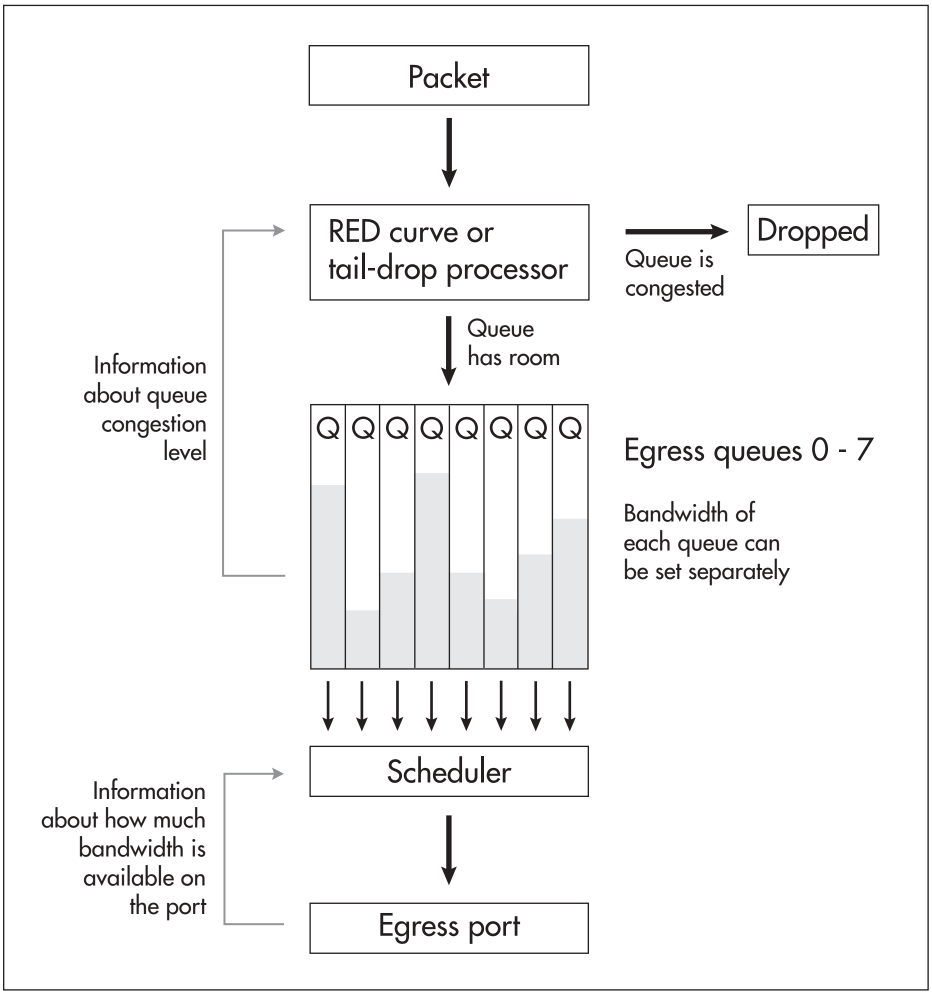


Figure 4: Detailed packet flow at the queueing and egress stages of Figure 3 on page 12


Packet
RED curve or tail-drop processor
Dropped
Queue is congested
Queue has room
Information about queue congestion level
Q Q Q Q Q Q Q Q
Egress queues 0 - 7
Bandwidth of each queue can be set separately
Scheduler
Information about how much bandwidth is available on the port
Egress port

QoS Policy Configuration Rules

The QoS policy configuration rules on the switch are:

1. A classifier may be assigned to many flow groups. However, assigning a classifier more than once within the same policy may lead to undesirable results. A classifier may be used successfully in many different policies.
2. A flow group may have many classifiers.
3. A flow group may only be assigned to one traffic class.
4. A traffic class may have many flow groups.
5. A traffic class may only be assigned to one policy.
6. A policy may have many traffic classes.
7. A policy may be assigned to many ports.
8. A port may only have one policy.

Destroying a QoS Element

The components that make up a QoS solution are created as individual elements.

Destroying a policy will not destroy any of the underlying entities. A logical link is created when a traffic class is added to a policy. Destroying the policy will only unlink the traffic class, leaving the traffic class in an unassigned state.

Similarly, destroying traffic classes will simply unlink flow groups and destroying flow groups will simply unlink classifiers.

A RED curve set (see "*QoS RED Curves*" on page 24) is referenced by setting the RED parameter on a port. Destroying the port settings leaves the RED curve set intact.

Classifiers

Classifiers are used to identify a particular traffic flow and range from general to specific.

Do not use a single classifier in different flows that will end up, via traffic classes, assigned to the same policy. Use a classifier only once per policy.

To create a classifier, use the command:

```
CREATE CLASSIFIER
```

For detailed information about how to configure classifiers, see the *Generic Packet Classifier* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

To assign classifiers to a flow group, use the command:

```
ADD QOS FLOWGROUP=flowgroup-id CLASSIFIER=classifier-list
```

To delete one or more classifiers from a flow group, use the command

```
DELETE QOS FLOWGROUP=flowgroup-id
    CLASSIFIER={classifier-list|ALL}
```

QoS Flow Groups

Flow groups are used to group similar traffic together and consist of a small set of QoS parameters and a group of classifiers. Flow groups allow the use of more specific QoS controls in preference to controls specified by the traffic class.

You can add a flow group to one traffic class only. A traffic class may have many flow groups, and traffic is matched in order of flow group identifier, beginning from the lowest numbered flow group.

A maximum of 1024 flow groups are supported, numbered from 0 to 1023.

To create a flow group, use the command:

```
CREATE QOS FLOWGROUP=flowgroup-list [DESCRIPTION=description]
    [MARKVALUE={dscp-value|NONE}] [PREMARKING={USEMARKVALUE|
    USEDSCP|NONE}]
```

To modify the properties of a flow group, use the command:

```
SET QOS FLOWGROUP=flowgroup-list [DESCRIPTION=description]
    [MARKVALUE={dscp-value|NONE}] [PREMARKING={USEMARKVALUE|
    USEDSCP|NONE}]
```

To assign flow groups to a traffic class, use the command:

```
ADD QOS TRAFFICCLASS=tcid FLOWGROUP=flowgroup-list
```

To delete a flow group from a traffic class, use the command:

```
DELETE QOS TRAFFICCLASS=tcid FLOWGROUP={flowgroup-list|ALL}
```

To display configuration information for one or more flow groups, use the command:

```
SHOW QOS FLOWGROUP [={id|ALL}]
```

QoS Traffic Classes

Traffic classes are the central component of the QoS solution and consist of a set of QoS parameters and a group of flow groups. You can specify that traffic is premarked, metered, dropped, and remarked. This functionality is described in:

- *"Premarking"* on page 17
- *"Bandwidth Metering"* on page 19
- *"Remarking"* on page 22

If packets do not match these traffic classes they are handled by the default traffic class. The default traffic class is described below.

You can assign a traffic class to one policy only. Once assigned to a policy, a traffic class cannot be used by any other policy. Traffic is matched in order of traffic class identifier, beginning from the lowest numbered traffic class.

A maximum of 1024 traffic classes are supported, numbered from 0 to 1023.

The switch cannot check that the maximum bandwidth is available to this traffic class until you apply the traffic class's policy to a port.

To create a traffic class, use the command:

```
CREATE QOS TRAFFICCLASS=id-list [DESCRIPTION=description]
    [DROPBWCLASS3={YES|NO}] [IGNOREBWCLASS={YES|NO}]
    [MARKVALUE={dscp-value|NONE}] [MAXBANDWIDTH={bandwidth|
    NONE}] [MAXBURSTSIZE=burstsize] [MINBANDWIDTH={bandwidth|
    NONE}] [MINBURSTSIZE=burstsize] [PREMARKING={USEMARKVALUE|
    USEDSCP|NONE}] [REMARKING={USEDSCPMAP|BWCLASS|PRIORITY|
    PRIO+BWCLASS|NONE}]
```

To modify the properties of a traffic class, use the command:

```
SET QOS TRAFFICCLASS=id-list [DESCRIPTION=description]
    [DROPBWCLASS3={YES|NO}] [IGNOREBWCLASS={YES|NO}]
    [MARKVALUE={dscp-value|NONE}] [MAXBANDWIDTH={bandwidth|
    NONE}] [MAXBURSTSIZE=burstsize] [MINBANDWIDTH={bandwidth|
    NONE}] [MINBURSTSIZE=burstsize] [PREMARKING={USEMARKVALUE|
    USEDSCP|NONE}] [REMARKING={USEDSCPMAP|BWCLASS|PRIORITY|
    PRIO+BWCLASS|NONE}]
```

To assign traffic classes to a policy, use the command:

```
ADD QOS POLICY=id TRAFFICCLASS=tcid-list
```

To delete a traffic class from a policy, use the command:

```
DELETE QOS POLICY=id TRAFFICCLASS={tcid-list|ALL}
```

To display configuration information for one or more traffic classes, use the command:

```
SHOW QOS TRAFFICCLASS[={id|ALL}]
```

Default Traffic Class

The default traffic class provides a catch-all for any traffic that does not match one of the traffic classes you assign to a policy.

The default traffic class supports the same premarking, metering, dropping and remarking functionality as a regular traffic class. The properties of the default traffic class are created and modified using the CREATE QOS POLICY and SET QOS POLICY commands.

QoS Policies

QoS Policies consist of a collection of user defined traffic classes and the default traffic class. For more information about the default traffic class see above. QoS controls are applied to traffic ingressing ports. Therefore, to control a particular type of traffic, an appropriate policy must be attached to each port that type of traffic ingresses.

You can assign a policy to more than one port, but a port may only have one policy.

The *AT-8900 Series Software Reference* for Software Release 2.6.1 incorrectly states that the maximum number of QoS policies supported is 512.

A maximum of 256 policies are supported, numbered from 0 to 255.

To create a policy and specify the default traffic class properties, use the command:

```
CREATE QOS POLICY=id-list [DESCRIPTION=description]
    [DTCDROPBWCLASS3={YES|NO}] [DTCIGNOREBWCLASS={YES|NO}]
    [DTCMAXBANDWIDTH={bandwidth|NONE}]
    [DTCMAXBURSTSIZE=burstsize] [DTCMINBANDWIDTH={bandwidth|
    NONE}] [DTCMINBURSTSIZE=burstsize]
    [DTCPREMARKING={USEMARKVALUE|USEDSCP|NONE}]
    [DTCREMARKING={USEDSCPMAP|BWCLASS|PRIORITY|PRIO+BWCLASS|
    NONE}] [MARKVALUE={dscp-value|NONE}]
```

To modify the properties of a policy or the default traffic class, use the command:

```
SET QOS POLICY=id-list [DESCRIPTION=description]
    [DTCDROPBWCLASS3={YES|NO}] [DTCIGNOREBWCLASS={YES|NO}]
    [DTCMAXBANDWIDTH={bandwidth|NONE}]
    [DTCMAXBURSTSIZE=burstsize] [DTCMINBANDWIDTH={bandwidth|
    NONE}] [DTCMINBURSTSIZE=burstsize]
    [DTCPREMARKING={USEMARKVALUE|USEDSCP|NONE}]
    [DTCREMARKING={USEDSCPMAP|BWCLASS|PRIORITY|PRIO+BWCLASS|
    NONE}] [MARKVALUE={dscp-value|NONE}]
```

To assign a policy to a port or ports, use the command:

```
SET QOS PORT={port-list|ALL} [POLICY={id|NONE}]
    [DEFAULTQUEUE=queue-number] [FORCEDEFQUEUE={YES|NO}]
    [RED={red-id|NONE}]
```

☞ *Note that error checking of parameters and parameter values for the policy is only performed when the policy is set on a port.*

To destroy a policy or policies, use the command:

```
DESTROY QOS POLICY={id-list|ALL}
```

To display configuration information for one or more policies, use the command:

```
SHOW QOS POLICY[={id|ALL}]
```

Premarking

Premarking occurs before any bandwidth metering is applied to a traffic class.

Premarking allows you to select new values for the DiffServ Code Point (DSCP), bandwidth class, internal queue, and VLAN Tag User Priority of a flow group or traffic class. These new values are based on either the DSCP values of the constituents of the flow group or traffic class, or by using a nominated mark-value to index a preset, user defined DSCP mapping table.

Set the properties of the DSCPMAP table

As described above, one of the options for premarking is the DSCP mapping table. For each DSCP value, the table contains new values which the switch will assign for:

- bandwidth class
- DSCP
- Egress Queue
- VLAN Tag User Priority

To change the table's entries for a particular DSCP, use the command:

```
SET QOS DSCPMAP=PREMARKING DSCP=dscp-list
    [NEWBWCLASS=bandwidth-class] [NEWDSCP=dscp-value]
    [NEWPRIORITY=vlan-priority] [NEWQUEUE=queuenumber]
```

For NEWDSCP, the table's initial value is the value specified in the DSCP parameter. For NEWBWCLASS, the initial value is 1. For NEWPRIORITY and NEWQUEUE, the initial value is 0 (zero). If you specify any one of these parameters, you must specify a value for it; there is no default.

Apply premarking to a flow group or traffic class

To specify premarking, use the commands:

```
CREATE QOS FLOWGROUP=flowgroup-list
    [MARKVALUE={dscp-value|NONE}]
    PREMARKING={USEMARKVALUE|USEDSCP|NONE} [other-parameters]

SET QOS FLOWGROUP=flowgroup-list
    [MARKVALUE={dscp-value|NONE}]
    PREMARKING={USEMARKVALUE|USEDSCP|NONE} [other-parameters]

CREATE QOS TRAFFICCLASS=id-list [MARKVALUE={dscp-value|NONE}]
    PREMARKING={USEMARKVALUE|USEDSCP|NONE} [other-parameters]

SET QOS TRAFFICCLASS=id-list [MARKVALUE={dscp-value|NONE}]
    PREMARKING={USEMARKVALUE|USEDSCP|NONE} [other-parameters]
```

☞ *If PREMARKING is specified for a flow group, these settings override the PREMARKING settings specified for a traffic class.*

If PREMARKING=USEDSCP is specified, the QoS settings for the traffic flow are selected from the DSCPMAP table using the DSCP value in the matching data frames and a bandwidth class value of 1.

If PREMARKING=USEMARKVALUE is specified, the QoS settings for the traffic flow are selected from the DSCPMAP table using MARKVALUE and a bandwidth class of 1. The MARKVALUE parameter specifies an explicit value to use as an index into the DSCPMAP table when the PREMARKING parameter is set to USEMARKVALUE. MARKVALUE must be set to a valid DSCP value to allow this action.

If PREMARKING=NONE is specified for the CREATE QOS FLOWGROUP or SET QOS FLOWGROUP command, the traffic flow is passed to the traffic class stage.

If PREMARKING=NONE is specified for the CREATE QOS TRAFFICCLASS or SET QOS TRAFFICCLASS command, the traffic flow is passed to the metering stage.

The default value for the PREMARKING and MARKVALUE parameters is NONE.

You can set the default traffic class for a policy to premarking using a DSCPMAP setting for which the new bandwidth class is 2. This forces the default traffic class into a lower forwarding preference group for all queues, ensuring that “legal” classified traffic is processed in preference. In addition, the default traffic class may be mapped to a lower priority queue, or the queue may be placed in a lower priority arbitration group.

For the default traffic class, to specify that premarking occurs before any traffic class bandwidth metering is applied, use the commands:

```
CREATE QOS POLICY=id-list DTCPREMARKING={USEMARKVALUE|
    USEDSCP|NONE} [MARKVALUE={dscp-value|NONE}]
    [other-parameters]

SET QOS POLICY=id-list DTCPREMARKING={USEMARKVALUE|USEDSCP|
    NONE} [MARKVALUE={dscp-value|NONE}] [other-parameters]
```

Bandwidth Metering

Metering allows you to select and specify the limits of the bandwidth allocation meter that measures the bandwidth used by a traffic class.

You can select either a single-rate bandwidth allocation meter, or twin-rate bandwidth allocation meter.

A twin-rate bandwidth allocation meter gives you greater sophistication in the management of traffic flows than a single-rate bandwidth allocation meter provides.

Based on the conformance of the traffic class to the bandwidth allocation meter limits, you can then specify that traffic is dropped, and/or that the QOS properties of the traffic flow are remarked.

The meter resolution varies according to the specific rate limits set. To ensure that the meter operates as closely as possible to the exact specified limits an adaptive meter rate calculation algorithm is used. The metering process supports a variable, user-defined tolerance to bursts of traffic (burstsize), in excess of the defined limits.

Bandwidth conformance classes

The bandwidth allocation meters employ a three-level bandwidth conformance class, or bandwidth class, classification scheme against which traffic is measured. The service level for each bandwidth class marker is shown in Table 4.

Table 4: Bandwidth conformance classes.

Bandwidth class marker	Service level
Bandwidth class 1	Best conformance; best access to available bandwidth; highest performance
Bandwidth class 2	Discretionary access to bandwidth
Bandwidth class 3	Lowest conformance; over acceptable limits, lowest performance

The bandwidth class marker provides a preferential service level for conforming traffic, while permitting the flexible treatment of marginal or non-conforming traffic during the remarking, congestion control, and egress stages.

How bandwidth and burstsize are specified

Bandwidth is specified in kilobits per second (kbps), in the range 0 to 16000000 kbps. You can specify this value in kbps, Mbps, or Gbps. If no unit suffix is specified, the value is read as kbps. If Mbps or Gbps is specified, the value may contain a decimal fraction, for example, 1.25 Mbps.

Burstsize is specified kilobytes (kbytes), in the range of 0 to 16000000 kbytes. You can specify this value in kbytes, Mbytes, or Gbytes. If no unit suffix is specified, the value is read as kbytes. If Mbytes or Gbytes is specified, the value may contain a decimal fraction, for example, 1.25 Mbytes.

A single-rate bandwidth allocation meter

A single-rate bandwidth allocation meter has one bandwidth threshold and two burstsize levels. See Table 5.

Table 5: Properties of a single-rate bandwidth allocation meter

Bandwidth class marker	Service level
Bandwidth class 1	Under maximum rate and under minimum burstsize.
Bandwidth class 2	Bursting between minimum and maximum burstsize.
Bandwidth class 3	Over maximum rate and over maximum burstsize.

Specifying single-rate bandwidth metering properties

To create and modify the single-rate bandwidth metering properties for a traffic class, use the commands:

```
CREATE QOS TRAFFICCLASS=id-list [DROPBWCLASS3={YES|NO}]
    MAXBANDWIDTH={bandwidth|NONE} MAXBURSTSIZE=burstsize
    MINBURSTSIZE=burstsize [other-parameters]
```

```
SET QOS TRAFFICCLASS=id-list [DROPBWCLASS3={YES|NO}]
    MAXBANDWIDTH={bandwidth|NONE} MAXBURSTSIZE=burstsize
    MINBURSTSIZE=burstsize [other-parameters]
```

The DROPBWCLASS3 parameter specifies whether frames exceeding the traffic class MAXBANDWIDTH setting are dropped. Setting this parameter to YES indicates that data received on this traffic class at a rate higher than the combined MAXBANDWIDTH and MAXBURSTSIZE settings allow is dropped immediately. Setting this parameter to NO marks non-conforming traffic as bandwidth class 3 and allows non-conforming traffic to be selected for dropping by the RED curve settings, which have a more TCP-friendly algorithm. The default value is NO.

The MAXBANDWIDTH parameter specifies the bandwidth available to the traffic class. The MAXBANDWIDTH parameter determines the maximum data rate for bandwidth class 1 and 2. The default is NONE.

The MAXBURSTSIZE parameter specifies the burst tolerance for MAXBANDWIDTH. The MAXBURSTSIZE parameter determines the maximum amount of data permitted above MAXBANDWIDTH for the traffic class before frames are remarked to bandwidth class 3, or frames are dropped depending on the setting of DROPBWCLASS3. MAXBURSTSIZE should always be as least as large as the largest size packet to be metered on the aggregate flow. The default value is 0 (zero).

The MINBURSTSIZE parameter determines the maximum amount of data permitted above MAXBANDWIDTH for the traffic class before remarking to bandwidth class 2 occurs. The default value is 0 (zero).

To create and modify the single-rate bandwidth metering properties for the default traffic class, use the commands:

```
CREATE QOS POLICY=id-list [DTCDROPBWCLASS3={YES|NO}]
    DTCMAXBANDWIDTH={bandwidth|NONE}
    DTCMAXBURSTSIZE=burstsize
    DTCMINBURSTSIZE=burstsize [other-parameters]
```

```
SET QOS POLICY=id-list [DTCDROPBWCLASS3={YES|NO}]
    DTCMAXBANDWIDTH={bandwidth|NONE}
    DTCMAXBURSTSIZE=burstsize
    DTCMINBURSTSIZE=burstsize [other-parameters]
```

A twin-rate bandwidth allocation meter

A twin-rate bandwidth allocation meter has a minimum bandwidth threshold and a maximum bandwidth threshold, and one level of burst per minimum and maximum threshold. See Table 6.

Table 6: Properties of a twin-rate bandwidth allocation meter

Bandwidth class marker	Service level
Bandwidth class 1	Under minimum rate and under minimum burstsize.
Bandwidth class 2	Over minimum rate and burstsize and under maximum rate and burstsize.
Bandwidth class 3	Over maximum rate and maximum burstsize.

Specifying twin-rate bandwidth metering properties

To create and modify the twin-rate bandwidth metering properties for a traffic class, use the commands:

```
CREATE QOS TRAFFICCLASS=id-list [DROPBWCLASS3={YES|NO}]
    MAXBANDWIDTH={bandwidth|NONE} MAXBURSTSIZE=burstsize
    MINBANDWIDTH={bandwidth|NONE} MINBURSTSIZE=burstsize
    [other-parameters]

SET QOS TRAFFICCLASS=id-list [DROPBWCLASS3={YES|NO}]
    MAXBANDWIDTH={bandwidth|NONE} MAXBURSTSIZE=burstsize
    MINBANDWIDTH={bandwidth|NONE} MINBURSTSIZE=burstsize
    [other-parameters]
```

The DROPBWCLASS3 parameter specifies whether frames exceeding the traffic class MAXBANDWIDTH setting are dropped. Setting this parameter to YES indicates that data received on this traffic class at a rate higher than the combined MAXBANDWIDTH and MAXBURSTSIZE settings allow is dropped immediately. Setting this parameter to NO marks non-conforming traffic as bandwidth class 3 and allows non-conforming traffic to be selected for dropping by the RED curve settings, which have a more TCP-friendly algorithm. The default value is NO.

The MAXBANDWIDTH parameter specifies the maximum bandwidth available to the traffic class. The MAXBANDWIDTH parameter determines the maximum data rate for bandwidth class 2. The default maximum bandwidth is NONE.

The MAXBURSTSIZE parameter specifies the burst tolerance for MAXBANDWIDTH. The MAXBURSTSIZE parameter determines the maximum amount of data permitted above MAXBANDWIDTH for the traffic class before remarking to bandwidth class 3 occurs, or frames are dropped depending on the setting of DROPBWCLASS3. MAXBURSTSIZE should always be as least as large as the largest size packet to be metered on the aggregate flow. The default value is 0 (zero).

The MINBANDWIDTH parameter specifies the minimum bandwidth reserved for the traffic class. The MINBANDWIDTH parameter determines the maximum rate of data in bandwidth class 1. The default is NONE.

The MINBURSTSIZE parameter specifies the burst tolerance for MINBANDWIDTH. The MINBURSTSIZE parameter determines the maximum amount of data permitted above MINBANDWIDTH for the traffic class before remarking to bandwidth class 2 occurs. The default value is 0 (zero).

To create and modify the twin-rate bandwidth metering properties for the default traffic class, use the commands:

```
CREATE QOS POLICY=id-list [DTCDROPBWCLASS3={YES|NO}]
    DTCMAXBANDWIDTH={bandwidth|NONE}
    DTCMAXBURSTSIZE=burstsize
    DTCMINBANDWIDTH={bandwidth|NONE}
    DTCMINBURSTSIZE=burstsize [other-parameters]

SET QOS POLICY=id-list [DTCDROPBWCLASS3={YES|NO}]
    DTCMAXBANDWIDTH={bandwidth|NONE}
    DTCMAXBURSTSIZE=burstsize
    DTCMINBANDWIDTH={bandwidth|NONE}
    DTCMINBURSTSIZE=burstsize [other-parameters]
```

Remarking

Remarking allows you to specify the action to take on the traffic flow after the metering stage.

During metering, a temporary value of bandwidth class is assigned to the traffic flow which is used to determine its per-hop behaviour. You can specify that frames are remarked according to their bandwidth limit conformance calculation after metering.

Specifying remarking properties

To create and modify the remarking properties for a traffic class, use the commands:

```
CREATE QOS TRAFFICCLASS=id-list REMARKING={USEDSCPMAP|
    BWCLASS|PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]

SET QOS TRAFFICCLASS=id-list REMARKING={USEDSCPMAP|BWCLASS|
    PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]
```

To create and modify the remarking properties for the default traffic class, use the commands:

```
CREATE QOS POLICY=id-list REMARKING={USEDSCPMAP|BWCLASS|
    PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]

SET QOS POLICY=id-list REMARKING={USEDSCPMAP|BWCLASS|
    PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]
```

If BWCLASS or PRIO+BWCLASS are specified, the temporary bandwidth class becomes the new bandwidth class for the flow.

If PRIORITY or PRIO+BWCLASS are specified, the currently assigned queue for frames in the traffic class is used in conjunction with the temporary value of bandwidth class to determine the new value of the VLAN Tag User Priority field from the QUEUE2PRIOMAP table (see "*Set the properties of the QUEUE2PRIOMAP table*" on page 24).

If USEDSCPMAP is specified, the temporary value of bandwidth class is used, in conjunction with the DiffServ Code Point (DSCP) of the frame, as an index into the DSCPMAP table. The DSCPMAP table then assigns the actual, new values for bandwidth class, DSCP, Egress Queue and VLAN Tag User Priority (see "*Set the properties of the DSCPMAP table*" below).

If NONE is specified, no remarking occurs. This is the default value.

Set the properties of the DSCPMAP table

As described above, one of the options for remarking is the DSCP mapping table. For each temporary bandwidth class and DSCP value, the table contains new values which the switch will assign for:

- bandwidth class
- DSCP
- Egress Queue
- VLAN Tag User Priority

Using the DSCP mapping table allows you to specify the per-hop remarking actions for each frame according to the frame's previous DSCP and bandwidth class. An example of the beginning of the table is shown in Table 7.

Table 7: A conceptual example of part of the DSCP mapping table

BWCLASS DSCP	Class 1	Class 2	Class 3
0	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE
1	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE	NEWBWCLASS NEWDSCP NEWPRIORITY NEWQUEUE

To change the table's entries for a particular DSCP and bandwidth class, use the command:

```
SET QOS DSCPMAP=REMARKING DSCP=dscp-list BWCLASS=bwclass-list
    [NEWBWCLASS=bandwidth-class] [NEWDSCP=dscp-value]
    [NEWPRIORITY=vlan-priority] [NEWQUEUE=queuenumber]
```

For NEWDSCP, the table's initial value is the value specified in the DSCP parameter. For NEWBWCLASS, the initial value is the value specified in the BWCLASS parameter. For NEWPRIORITY and NEWQUEUE, the initial value is 0 (zero). If you specify any one of these parameters, you must specify a value for it; there is no default. See Table 8 for a conceptual example of part of the table including initial values.

Table 8: Initial values in the DSCPMAP table

BWCLASS DSCP	Class 1	Class 2	Class 3

0	NEWBWCLASS=1
	NEWDSCP=0
	NEWPRIORITY=0
	NEWQUEUE=0
		NEWBWCLASS=2
		NEWDSCP=0
		NEWPRIORITY=0
		NEWQUEUE=0
			NEWBWCLASS=3
			NEWDSCP=0
			NEWPRIORITY=0
			NEWQUEUE=0

1	NEWBWCLASS=1
	NEWDSCP=1
	NEWPRIORITY=0
	NEWQUEUE=0
		NEWBWCLASS=2
		NEWDSCP=1
		NEWPRIORITY=0
		NEWQUEUE=0
			NEWBWCLASS=3
			NEWDSCP=1
			NEWPRIORITY=0
			NEWQUEUE=0

Set the properties of the QUEUE2PRIOMAP table

As described in "*Specifying remarking properties*" on page 22, another of the options for remarking is the queue-to-priority mapping table. For each temporary bandwidth class and currently-assigned queue, the table contains a new value of the VLAN Tag User Priority.

To change the table's entries for a particular queue and bandwidth class, use the command:

```
SET QOS QUEUE2PRIOMAP QUEUE=queue-list BWCLASS=bwclasslist
    [NEWPRIORITY=vlan-priority]
```

The default for NEWPRIORITY is 0 (zero).

QoS RED Curves

Random Early Detection/Discard (RED) is a congestion avoidance mechanism that allows some packets to be dropped before the egress queue exceeds the allocated maximum queue length. Lower priority packets are dropped when severe congestion occurs, with progressively more and higher priority packets dropped until congestion is eased. This is useful for TCP flows, because the sender will slow the rate of transmission when it detects a packet loss. Note that using RED on UDP traffic flows is not recommended because UDP does not reduce the rate of transmission and will simply retransmit the dropped packets, which will add to the congestion.

On the AT-8900 switch, RED Curve functionality is implemented on egress ports.

A total of four global, user-definable sets of RED Curves are supported. One RED Curve set exists by default. You can configure the default RED Curve set and can create and configure up to three more RED Curve sets. Each RED Curve set has eight RED curves, one for each egress queue. There are eight egress queues per port. Each RED curve has three thresholds, one for each bandwidth class. For more information on bandwidth classes see "*Bandwidth conformance classes*" on page 19.

The parameters used in defining a RED curve are:

- START
  The average length of the queue in bytes below which packets are always accepted.
- STOP
  The average length of the queue in bytes above which packets are always discarded.
- DROP
  Drop probability at the queue length determined by the STOP value.

The queue length for RED Probability calculations is measured in numbers of bytes. Since the maximum length for an Egress Queue is set in terms of frames, the relationship between the Egress Queue and the queue length for RED Probability calculations varies, depending on the particular mix of traffic at any time. The range of the user definable RED Curve parameters is not restricted in consideration of this. If the Egress Queue Length is not correctly taken into account some possible user configurations may not result in the expected RED Control behaviour.

To create a RED Curve set, use the command:

```
CREATE QOS RED=red-id [DESCRIPTION=description]
```

All RED Curve set parameters are set to the default values. Note that the Default RED curve set (RED=1) exists at startup and therefore cannot be created or destroyed.

To set the properties of a specified RED Curve set for a queue or queues, use the command:

```
SET QOS RED=red-id [AVERAGING=averaging-factor]
    [DESCRIPTION=description] [QUEUE=queue-list]
    [START1=start] [STOP1=stop] [DROP1=probability]
    [START2=start] [STOP2=stop] [DROP2=probability]
    [START3=start] [STOP3=stop] [DROP3=probability]
```

The AVERAGING parameter specifies the weight, in the range 0 to 15, to use in the time-based averaging calculation of queue length for the RED curve algorithm. If a value of 0 is specified, the average queue length will follow the actual queue length exactly. A larger AVERAGING value applies a longer time constant to the calculation. This improves the performance of TCP sessions around the STOP values by helping to avoid synchronous dropping of frames from all sessions on the queue. The default value is 9.

The QUEUE parameter specifies which queue(s) in the set have their settings updated by the specified values. If the QUEUE parameter is not specified, all queues in the set are updated with the new values. There is no default value.

The START, STOP, and DROP parameters set the thresholds for each of the three bandwidth classes.

The START1, STOP1, and DROP1 parameters are used to specify the RED settings for frames associated with bandwidth class 1.

The START2, STOP2, and DROP2 parameters are used to specify the RED settings for frames associated with bandwidth class 2.

The START3, STOP3, and DROP3 parameters are used to specify the RED settings for frames associated with bandwidth class 3.

To destroy a single RED Curve set, or all RED Curve sets, use the command:

```
DESTROY QOS RED={red-idlist|ALL}
```

To implement RED curve functionality you need to configure a port on the switch. You can configure each egress port to use any of the four global RED Curve sets. To specify that a port or ports use a specific RED curve set, use the command:

```
SET QOS PORT={port-list|ALL} RED=red-id [other-parameters]
```

To display configuration information about a RED curve set or all RED curve sets, use the command:

```
SHOW QOS RED[={red-id|ALL}] [QUEUE=queue-list]
```

Tail-drop discarding scheme

Tail-drop refers to the situation when packets are discarded from the logical tail of the queue when there is no further queue space left.

You can configure an egress port to use a three tail-drop discarding scheme using a subset of the parameters for the default RED Curve set (RED=1). The Tail-drop discarding scheme uses the STOP1, STOP2, and STOP3 values for each queue in the default RED Curve set. If a queue has a length greater than STOP3 then no frames with bandwidth class 3 are added to the queue, they are dropped.

To specify that a port or ports use the Tail-drop discarding scheme, use the command:

```
SET QOS PORT={port-list|ALL} RED=NONE [other-parameters]
```

Replacing Priorities on Egress

If the switch determines priority on the basis of the traffic class or flow group priority, that priority only determines the queue a packet is sent to when it egresses this switch. By default, it has no effect on how the rest of the network processes the packet. To permanently change the packet’s priority, you need to replace one of two priority fields in the packet header, either:

- the DSCP value of the IP header’s TOS byte, or
- the User Priority field of the VLAN tag header.

DSCP value

Replacing the DSCP value of the IP header’s TOS byte on egress may be required as part of the configuration of an edge switch in a DiffServ domain. For information on using the QoS policy model and the DSCP value to configure a DiffServ domain, see “*DiffServ Domains*” on page 28.

To replace the DSCP value of a packet, use the commands:

```
CREATE QOS TRAFFICCLASS=id-list REMARKING=USEDSCPMAP
   [other-parameters]

SET QOS TRAFFICCLASS=id-list REMARKING=USEDSCPMAP
   [other-parameters]
```

The REMARKING parameter specifies the action to take after the metering stage.

The USEDSCPMAP option specifies that the temporary value of bandwidth conformance class is used (in conjunction with the DSCP of the frame) as an index into the DSCPMAP mapping table, which then assigns the actual, new values for bandwidth class, DSCP, Egress Queue and VLAN Tag User Priority.

To set the properties of the DSCP mapping table, use the command:

```
SET QOS DSCPMAP [={PREMARKING|REMARKING}] DSCP=dscp-list
    BWCLASS=bwclass-list [NEWDSCP=dscp-value]
    [NEWBWCLASS=bandwidth-class] [NEWQUEUE=queuenumber]
    [NEWPRIORITY=vlan-priority]
```

In the DSCP mapping table, for each DSCP value there are three sets of QOS parameter values, one per bandwidth class. This allows you to specify the per-hop remarking actions for each frame according to the frames previous DSCP and bandwidth class.

VLAN Tag Priority field

Replacing the User Priority field of the VLAN tag header relabels VLAN-tagged traffic, so that the next switch can process traffic appropriately. Replacing the User Priority field is most useful outside DiffServ domains. You can specify that the VLAN Tag Priority field is replaced for tagged frames at ingress and is set for untagged frames at egress.

To specify that the VLAN Tag Priority field of tagged frames is replaced, use the commands:

```
CREATE QOS TRAFFICCLASS=id-list REMARKING={USEDSCPMAP|
    BWCLASS|PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]

SET QOS TRAFFICCLASS=id-list REMARKING={USEDSCPMAP|BWCLASS|
    PRIORITY|PRIO+BWCLASS|NONE} [other-parameters]
```

The USEDSCPMAP option specifies that the temporary value of bandwidth conformance class is used (in conjunction with the DSCP of the frame) as an index into DSCPMAP, which then assigns the actual, new values for bandwidth class, DSCP, Egress Queue and VLAN Tag User Priority.

The PRIORITY or PRIO+BWCLASS options specify that the currently assigned queue for frames in this Traffic Class is used in conjunction with the temporary bandwidth class to determine the new value of the VLAN Tag Priority field from the QUEUE2PRIOMAP table.

The default is NONE.

To set the properties of the QUEUE2PRIOMAP table, use the command:

```
SET QOS QUEUE2PRIOMAP QUEUE=queue-list BWCLASS=bwclasslist
    [NEWPRIORITY=vlan-priority]
```

The QUEUE parameter specifies which queue(s) to update with the specified settings. A value must be supplied as there is no default.

The BWCLASS parameter specifies the value(s) of bandwidth class for which the priority value should be updated.

The NEWPRIORITY parameter specifies the new VLAN Tag User Priority to use for each frame, selected by the frames internal queue and bandwidth class indexes.

To set the VLAN Tag Priority field assigned at egress for frames that were untagged at ingress, use the command:

```
SET QOS DEFAULTPRIORITY=q0,q1,q2,q3,q4,q5,q6,q7
```

The integers *p0* to *p7* represent the VLAN Tag User Priority corresponding to an to an internal Class of Service queue. All eight values are required. The first value, *q0*, represents the VLAN Tag User Priority corresponding to an internal Class of Service queue of 0 (zero), and similarly values *q1* to *q7* represent the VLAN Tag User Priority corresponding to an internal Class of Service queue of 1 to 7. The default set of values is 1,2,0,3,4,5,6,7. This is the reverse of the default PRIO2QUEUEMAP setting.

Only frames that do not have a User Priority value assigned by any other QoS mechanism have a value assigned this way.

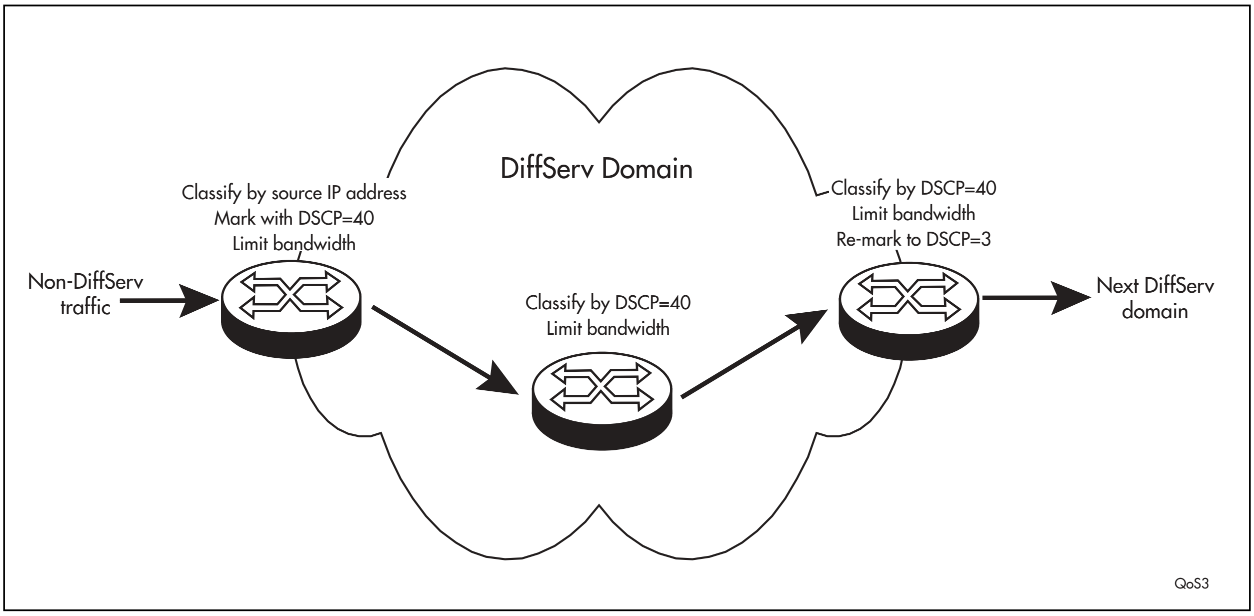
DiffServ Domains

Differentiated Services (DiffServ) is a method of dividing IP traffic into classes of service without requiring that every router in a network remember detailed information about traffic flows.

DiffServ operates within a *DiffServ domain*, a network or subnet managed as a single QoS unit. Packets are classified according to user-specified criteria at the edge of the network, divided into classes, and assigned the required class of service. Packets are then marked with a Differentiated Services Code Point (DSCP) tag to indicate the class of service to which they belong. The DSCP value is written into the TOS field of the IP header. Routers within the network then use this DSCP value to classify packets and assign QoS appropriately. When a packet leaves the DiffServ domain, the DSCP value can be replaced with a value appropriate for the next DiffServ domain.

A simple example of the process for limiting the amount of bandwidth used by traffic from a particular IP address is shown in Figure 5. In the domain shown, this bandwidth limit is supplied by the class of service represented by a DSCP value of 40. In the next DiffServ domain, this traffic is assigned to the class of service represented by a DSCP value of 3.

Figure 5: An example of a DiffServ domain.



To use the QoS tool set to configure a DiffServ domain:

1. Classify the packets coming into the domain at edge switches, according to the required characteristics. For available options, see the CREATE CLASSIFIER command in the *Generic Packet Classifier* chapter, *AT-8900 Series Software Reference*.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority, RED curve and/or bandwidth limiting controls that are required for that type of packet within this part of the domain.

   Assign a DSCP value to each traffic class, to be written into the TOS field of the packet header, using the MARKVALUE parameter of the CREATE TRAFFIC CLASS or SET TRAFFIC CLASS commands.

2. On switches and routers within the DiffServe domain, classify packets according to the DSCP values that were assigned to traffic classes on the edge switches.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority, RED curve and/or bandwidth limiting controls that are required for that type of packet within this part of the domain. These QoS controls need not be the same for each switch.

3. As packets leave the DiffServ domain, classify them according to the DSCP values.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority, RED curve and/or bandwidth limiting controls required for transmission of that type of packet to its next destination, in accordance with any Service Level Agreement (SLA) with the providers of that destination.

   If necessary, assign a different DSCP value to each traffic class, to be written into the TOS field of the packet header, to match the DSCP or TOS priority values of the destination network.

How to Enable DiffServ QoS Functionality on the switch

The switch will process traffic for Quality Of Service according to the guidelines provided by RFC2475 (An Architecture for Differentiated Services). DSCP-based classification, marking and meter-based remarking are supported.

To enable DiffServ QoS functionality on the switch follow these steps:

1. Create classifiers, flow groups, traffic classes and policies

To create the QoS elements and specify the functionality of these elements, use the following commands:

```
CREATE CLASSIFIER

CREATE QOS FLOWGROUP=flowgroup-list [other-parameters]

CREATE QOS TRAFFICCLASS=id-list [other-parameters]

CREATE QOS POLICY=id-list [other-parameters]
```

The default traffic class values are specified with the CREATE QOS POLICY command.

2. Set the properties of the DSCP-based QoS marking tables

If premarking or remarking functionality is specified in either the CREATE QOS FLOWGROUP, CREATE QOS TRAFFICCLASS, or CREATE QOS POLICY commands, you need to set the properties of the DSCP-based QoS marking tables.

To set the properties of the DSCP-based QoS marking tables, use the command:

```
SET QOS DSCPMAP [={PREMARKING|REMARKING}] DSCP=dscp-list
    BWCLASS=bwclass-list [NEWDSCP=dscp-value]
    [NEWBWCLASS=bandwidth-class] [NEWQUEUE=queuenumber]
    [NEWPRIORITY=vlan-priority]
```

3. Add classifiers to a flow group, add flow groups to a traffic class, and add traffic classes to a policy

To logically link QoS elements, use the following commands:

```
ADD QOS FLOWGROUP=flowgroup-id CLASSIFIER=classifier-list

ADD QOS TRAFFICCLASS=tcid FLOWGROUP=flowgroup-list

ADD QOS POLICY=id TRAFFICCLASS=tcid-list
```

Note that if premarking is specified with the CREATE QOS FLOWGROUP command, this overrides premarking specified with the CREATE QOS TRAFFICCLASS command.

4. For congestion control set the RED curve values

To create RED curve sets and then set the properties of these RED curve sets, use the following commands:

```
CREATE QOS RED=red-id [DESCRIPTION=description]

SET QOS RED=red-id [AVERAGING=averaging-factor]
    [DESCRIPTION=description] [QUEUE=queue-list]
    [START1=start] [STOP1=stop] [DROP1=probability]
    [START2=start] [STOP2=stop] [DROP2=probability]
    [START3=start] [STOP3=stop] [DROP3=probability]
```

A RED curve set is assigned to a port with the SET QOS PORT command.

5. **Set the egress queue parameters for a port**

   To update the parameters for all or specific egress queues on a port, use the command:

   ```
   SET QOS PORT={port-list|ALL} EGRESSQUEUE=queue-list
      [other-parameters]
   ```

   This command is used to rate limit and/or force congestion control of normally uncontested traffic.

6. **Assign the policy to a port**

   To assign a policy to one or more ports, use the command:

   ```
   SET QOS PORT={port-list|ALL} [POLICY={id|NONE}]
      [DEFAULTQUEUE=queue-number] [FORCEDEFQUEUE={YES|NO}]
      [RED={red-id|NONE}]
   ```

   Note that a port can have only one QoS policy assigned to it.

7. **Set the maximum bandwidth available to a port**

   By default, the maximum bandwidth is available to a port. To restrict the maximum bandwidth available to a port, use the command:

   ```
   SET SWITCH PORT={port-list|ALL}
      EGRESSLIMIT={bandwidth|DEFAULT} [other-parameters]
   ```

   The EGRESSLIMIT parameter specifies the maximum bandwidth available to the port in multiples of 64 kbps. The EGRESSLIMIT parameter does not set the exact bandwidth of the port. Rather, the parameter is a measurement of the rate at which data leaves internal queues before it is transmitted onto the line. Header and trailer information encapsulated in the frame are not included in the calculation. The size of the frame impacts upon the actual data transmission rate that the port can transmit onto the line. Therefore, the larger the frame size the closer that the actual percentage of bandwidth on line will get to the bandwidth set.

   For more detailed information see the SET SWITCH PORT command in the *Switching* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Layer 2 Priority-based QoS

The switch will support Quality Of Service based on Layer 2 parameters for non-DiffServ compatible traffic. The selection of an egress queue based on the Layer 2 VLAN Tag Priority Field is supported for frames that are tagged at ingress, or by selecting a default queue per port for untagged frames. Meter remarking of Layer 2 priority on the basis of the selected egress queue and metering bandwidth conformance class is supported. Frames that are untagged at ingress and do not have their priority set during the marking or remarking stages, have the egress VLAN Tag Priority value selected from a user definable mapping of queue values to priority values.

How to Enable Layer 2 QoS Functionality on the switch

To enable Layer 2 priority-based QoS functionality on the switch follow these steps:

1. **Set queue based QoS remarking**

   Queue based remarking is specified by the CREATE QOS TRAFFICCLASS command.

   To specify queue based remarking of VLAN Tag User Priority field, use either of the commands:

   ```
   CREATE QOS TRAFFICCLASS=id-list
      REMARKING=PRIORITY [other-parameters]
   ```

   ```
   CREATE QOS TRAFFICCLASS=id-list
      REMARKING=PRIO+BWCLASS [other-parameters]
   ```

   The PRIORITY and PRIO+BWCLASS options specify that the currently assigned queue for frames in this traffic class is used in conjunction with the temporary bandwidth class to determine the new value of the VLAN Tag User Priority field from the QUEUE2PRIOMAP table.

   The QUEUE2PRIOMAP table specifies the QoS remarking parameters indexed by the CREATE QOS TRAFFICCLASS command.

   To set the properties of the QUEUE2PRIOMAP table, use the command:

   ```
   SET QOS QUEUE2PRIOMAP=queue-list BWCLASS=bwclasslist
      NEWPRIORITY=vlan-priority
   ```

   The BWCLASS parameter specifies the value(s) of bandwidth class for which the priority value should be updated.

   The NEWPRIORITY parameter specifies the new VLAN Tag User Priority to use for each frame, selected by the frames internal queue and bandwidth class indexes.

   To specify queue based remarking of the default traffic class, use either of the commands:

   ```
   CREATE QOS POLICY=id-list DTCREMARKING=PRIORITY
      [other-parameters]
   ```

   ```
   CREATE QOS POLICY=id-list DTCREMARKING=PRIO+BWCLASS
      [other-parameters]
   ```

   Note that the steps for assigning a traffic class to a policy, and a policy to a port, are not described here. These steps are described in “*How to Enable DiffServ QoS Functionality on the switch*” on page 30.

2. Set the initial queue assignment for tagged frames

To set the mapping of incoming VLAN Tag User Priorities to the internal service queues for ingressing packets that include a VLAN tag header, use the command:

```
SET QOS PRIO2QUEUEMAP=p0,p1,p2,p3,p4,p5,p6,p7
```

The integers *p0* to *p7* indicate the queue priority corresponding to an incoming VLAN Tag User Priority. All eight values are required. The first value, *p0*, represents the queue priority corresponding to an incoming VLAN Tag User Priority of 0 (zero), and similarly values *p1* to *p7* represent the queue priority corresponding to an incoming VLAN Tag User Priority of 1 to 7. The default values are 2,0,1,3,4,5,6,7 as recommended in IEEE 802.1q (1998) section 8.7.3.

3. Set the default queue for untagged frames ingressing a specified port

To set the default queue for untagged frames ingressing a specified port or ports and which have no VLAN Tag User Priority value, use the command:

```
SET QOS PORT={port-list|ALL} DEFAULTQUEUE=queue-number
    [other-parameters]
```

If the default queue is not reassigned by premarking and/or remarking, this will be the egress queue number.

4. Specify that all frames are forced to the default queue

To specify that all frames ingressing a specified port or ports are forced to the default queue, regardless of whether they are tagged or untagged, use the command:

```
SET QOS PORT={port-list|ALL} FORCEDEFQUEUE={YES|NO}
    [other-parameters]
```

5. Set the VLAN Tag Priority field assigned at egress

To set the VLAN Tag Priority field assigned at egress for frames that were untagged at ingress, i.e frames that had a queue assigned by the SET QOS PORT DEFAULTQUEUE command, use the command:

```
SET QOS DEFAULTPRIORITY=q0,q1,q2,q3,q4,q5,q6,q7
```

The integers *p0* to *p7* represent the VLAN Tag User Priority corresponding to an to an internal Class of Service queue. All eight values are required. The first value, *q0*, represents the VLAN Tag User Priority corresponding to an internal Class of Service queue of 0 (zero), and similarly values *q1* to *q7* represent the VLAN Tag User Priority corresponding to an internal Class of Service queue of 1 to 7. The default set of values is 1,2,0,3,4,5,6,7. This is the reverse of the default PRIO2QUEUEMAP setting.

Only frames that do not have a User Priority value assigned by any other QoS mechanism have a value assigned this way.

SET QOS QUEUE2PRIOMAP command

The command syntax for the SET QOS QUEUE2PRIOMAP command in the *AT-8900 Series Software Reference* is incorrect. The correct command syntax is:

```
SET QOS QUEUE2PRIOMAP QUEUE=queue-list BWCLASS=bwclasslist
   [NEWPRIORITY=vlan-priority]
```

where:

- *bwclasslist* is either an integer in the range 1 to 3; a range of integers (specified as 1-3) or a comma separated list of integers and/or ranges, without spaces.
- *queue-list* is either an integer in the range 0 to 7; a range of integers (specified as 0-3) or a comma separated list of integers and/or ranges, without spaces.
- *vlan-priority* is an integer in the range 0 to 7.

This command sets the queue-based QOS remarking parameters. For each queue value, the outgoing VLAN Tag User Priority may be set to one of three values, depending on its bandwidth class. Queue based remarking is selected by setting the Traffic Class REMARKING parameter to PRIORITY or PRIO+BWCLASS.

The QUEUE parameter specifies which queue(s) to update with the specified settings. A value must be supplied as there is no default.

The BWCLASS parameter specifies the value(s) of bandwidth class for which the priority value should be updated. If BWCLASS is not specified, the settings will apply for all values of bandwidth class on the specified queue(s), otherwise a value must be supplied.

The NEWPRIORITY parameter specifies the new VLAN Tag User Priority to use for each frame selected by its internal queue and bandwidth class indexes. The preset value for NEWPRIORITY is zero. If NEWPRIORITY is specified, a value must be supplied as there is no default.

Autonegotiation of port speed and duplex mode

For the 10/100Base-T ports, if one of 10MHALF, 10MFULL, 100MHALF, or 100MFULL is specified then autonegotiation is disabled and the interface is forced to operate at the specified speed and duplex mode, regardless of whether the link partner is capable of working at that speed.

The SFP uplink ports are fixed at full-duplex and at a speed of 1 Gbps.

Switch ports will autonegotiate by default when they are connected to a new device. To change this setting, use the command:

```
SET SWITCH PORT={port-list|ALL} SPEED={AUTONEGOTIATE|10MHALF|
   10MFULL|10MHAUTO|10MFAUTO|100MHALF|100MFULL|100MHAUTO|
   100MFAUTO|1000MFULL} [other-parameters]
```

Auto MDI/MDI-X

MDI and MDI-X are Medium Dependent Interface port configurations for copper based interfaces. An MDI interface at one end and an MDI-X (MDI crossover) interface at the other end of a straight-through cable ensures the correct correspondence between the transmitting and receiving interface cable pairs. If both ends have MDI interfaces, or both ends have MDI-X interfaces, a crossover cable is required. “Polarity” refers to whether a port operates as MDI or MDI-X.

The auto MDI/MDI-X feature enables a switch port to detect whether it needs to have MDI or MDI-X polarity for a link. This means that straight-through (or crossover) cables can be used to connect these ports, whatever the MDI or MDI-X polarity of the other end. Some switch ports perform auto MDI/MDI-X by default as part of port autonegotiation. On some ports you can disable this auto MDI/MDI-X feature so that the ports are configured with a fixed MDI or MDI-X polarity. To disable auto MDI/MDI-X, use the command:

```
DISABLE SWITCH PORT={port-list|ALL} AUTOMDI
```

When auto MDI/MDI-X is disabled, the switch port polarity is set to the default, MDI-X. To modify the fixed polarity, use the command:

```
SET SWITCH PORT={port-list|ALL} POLARITY={MDI|MDIX}
    [other-parameters]
```

You can use the commands above to configure the base ports. Copper SFP transceivers plugged into the SFP uplink sockets are auto MDI/MDI-X, and cannot be set to a fixed polarity. Fibre ports do not have MDI/MDI-X polarity.

Port trunking

Port trunking, also known as port bundling or link aggregation, allows a number of ports to be configured to join together to make a single logical connection of higher bandwidth. This can be used where a higher performance link is required and makes links even more reliable.

The switch supports up to 7 trunking groups, with to 4 ports per trunk group. Ports in the trunk group do not have to be contiguous.

The *AT-8900 Series Software Reference* for Software Release 2.6.1 incorrectly states that the maximum number of trunking groups supported is 31.

Broadcast Storm Protection

The storm control feature allows you to set limits on the reception rate of:

- broadcast and multicast packets on a per port basis, i.e one limit per port
- destination lookup packets for all ports on the switch, i.e one limit for the switch

The switch hardware counts separately the number of broadcast, multicast, and destination lookup failure packets in bytes received per second, and discards packets once the byte limit is reached.

The minimum rate is 100 Kbytes per second, increasing in steps of 100 Kbytes per second to the maximum rate of 95300 Kbytes per second.

Broadcast and multicast rate limiting

You can set one port limit for broadcast and multicast packet limiting. Therefore, the maximum reception rate limit is the same for both broadcast and multicast packets on a port and independent limits for broadcast and multicast packets cannot be set.

On a per port basis, you can enable:

- broadcast rate limiting
- broadcast and multicast rate limiting

It is not possible to have multicast rate limiting enabled without having broadcast limiting enabled.

If multicast rate limiting is enabled, then it is active for all ports that:

- already have broadcast limiting set and enabled
- subsequently have broadcast limiting enabled after multicast limiting is enabled

Multicast rate limiting is either on for all ports that have broadcast limiting enabled, or off for all ports.

To set broadcast storm control and the reception rate limit for a port or ports, use the command:

```
SET SWITCH PORT=port-list BCLIMIT={NONE|limit}
    [other-parameters]
```

where:

- *limit* is a decimal number between 0 and 95300, in Kbytes per second

To enable and disable the multicast storm control, which works in conjunction with broadcast limiting, use the command:

```
ENABLE SWITCH MCLIMITING
```

```
DISABLE SWITCH MCLIMITING
```

To display whether broadcast and multicast storm control is enabled or disabled for a port, or all ports, use the command:

```
SHOW SWITCH PORT=port-list
```

Destination lookup failure packets

Destination lookup failure packets have a Layer 2 destination address that the switch has not learnt and are in effect multicast packets. The switch does not know where to forward the packets, so the packets are broadcast to all ports on the switch. You can limit the rate at which destination lookup failure packets are received.

To set destination lookup failure rate limiting on the switch, use the command:

```
SET SWITCH DLFLIMIT={NONE|limit}
```

where:

- *limit* is a decimal number between 0 and 95300, in Kbytes per second

To display whether destination lookup failure storm control is enabled or disabled the switch, use the command:

```
SHOW SWITCH
```

VLAN Membership of Untagged Packets

The switch can determine the VLAN that incoming untagged packets belong to, on the basis of:

- *IP subnet:* The subnet that the packet came from, for IP packets
- *Protocol:* The protocol of the packet
- *Port*: The port the packet arrives to

VLANs are multi-typed and can have all 3 classification rules in any VLAN created. The VLAN associations available with this classification and their precedence are shown in Table 9.

Table 9: VLAN association and precedence.

VLAN classification	VLAN associations available with this classification	Precedence
Multi-typed	IP Subnet	Highest
	Protocol	Medium
	Port	Lowest

Creating VLANs

To briefly summarise the process of creating a VLAN:

1. Create the VLAN and specify its classification, one of IP subnet, protocol, or port.
2. Add tagged ports to the VLAN, if required.
3. Create associations to associate subnets and protocols with the VLAN if untagged ports are required. These associations determine the VLAN that incoming untagged packets belong to.
4. Add untagged ports to the associations.

Creating the VLAN and Specifying the VLAN Classification

Up to 4094 VLANs can be created, with VIDs ranging from 2 to 4094. VLANs do not have to be numbered consecutively. Creating a VLAN involves (in a single CREATE VLAN command) giving the VLAN a name, specifying a VID for the VLAN, and specifying its classification. A particular subnet or protocol can be associated with the VLAN at the same time, or later with the ADD VLAN command.

To create a IP subnet based VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094 [SUBNET=ipadd] [MASK=ipadd]
```

To create a protocol based VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094 [PROTOCOL=protocol-type]
```

To create a port based VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094
```

When any VLAN is created, an empty port association is automatically created. This allows untagged ports to be added to the VLAN without associating them with a subnet or protocol.

The Default VLAN

The default VLAN is created automatically when the switch is first powered up, and all the ports on the switch are added its port association.

The initial configuration of the default VLAN is unclassified. The VLAN can be given a classification type of IP subnet or protocol by adding an association to it, using the commands:

```
ADD VLAN=1 SUBNET=ipadd [MASK=ipadd]

ADD VLAN=1 PROTOCOL=protocol-type
```

If the default VLAN is the first VLAN on the switch to be classified, the classification it is given limits the classification of any other VLANs created, as described in Table 10. If another VLAN is created before the default VLAN is given a classification type, this sets the default VLAN’s classification.

Table 10: Types of VLAN available with each VLAN classification.

VLAN classification	Types of VLAN available with this classification
IP subnet-based	IP Subnet Protocol Port
Protocol-based	Protocol Port
Port-based	Port

Protected VLANs

The Protected VLAN feature prevents the members of a specified group of ports from communicating with each other, yet still allows these members to access another network. Ports on a switch that has Protected VLAN functionality enabled are given one of two states, either private (protected) or public. Private ports cannot talk to other private ports but can talk to public ports. Public ports can talk to both private or public ports.

All traffic received on a given port in a Protected VLAN is sent to a predefined defined uplink port, and only that uplink port, regardless of VLAN ID or MAC Destination address. Layer 2 traffic between ports that are members of a Protected VLAN is blocked. Traffic can be Layer 3 switched to another VLAN. To prevent Layer 3 Routing between ports in a Protected VLAN add a Layer 3 filter. The Protected VLAN feature also allows all members of a Protected VLAN to be in the same subnet.

A typical application is a hotel installation where each room has a port that can access the Internet. In this situation it is undesirable to allow communication between rooms.

To enable Protected VLAN functionality on the switch, use the command:

```
ENABLE VLAN PORTPROTECTED
```

To create a Protected VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094 PORTPROTECTED
```

The PROTECTED parameter specifies that the VLAN is a Protected VLAN.

To add ports to a Protected VLAN, use the command:

```
ADD VLAN={vlan-name|1..4094} PORT={port-list}
    [GROUP=group-number|uplink-number|UPLINK]
    [UPLINK=uplink-number] [other-parameters]
```

The GROUP parameter specifies that the ports are members of a Protected VLAN and are known as protected ports. Each group is unique and is identified by its group number. All traffic received on a protected port is sent to a predefined uplink port, or a group of uplink ports, called an uplink group.

To delete ports from a Protected VLAN, use the command:

```
DELETE VLAN={vlan-name|1..4094} PORT={port-list|ALL}
    [GROUP=group-number|uplink-number]
```

To disable Protected VLAN functionality on the switch, use the command:

```
DISABLE VLAN PORTPROTECTED
```

Multiple Spanning Trees and STP Interaction with VLANs

If creating multiple STPs in a network, a port in a switch can belong to multiple STPs if the port is a member of more than one VLAN

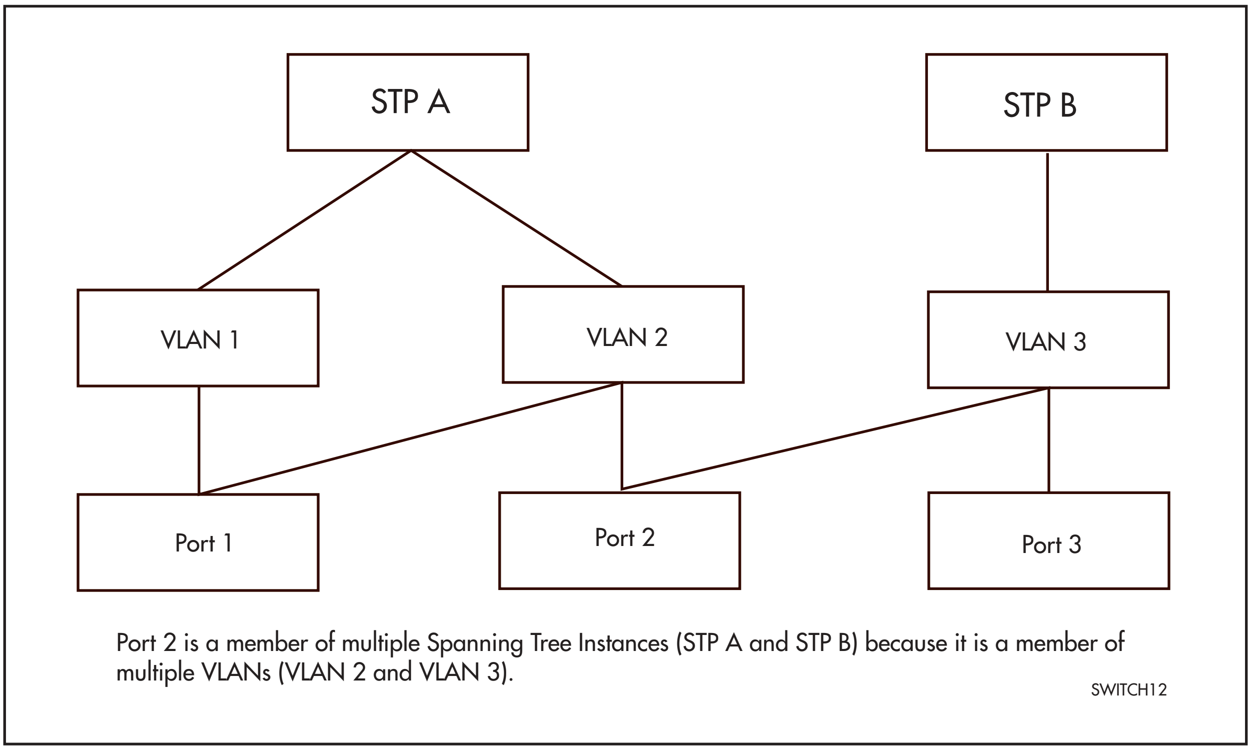
The *AT-8900 Series Software Reference* for Software Release 2.6.1 incorrectly states that if creating multiple STPs in a network, a port in a switch can belong to one STP only and that if a port is a member of multiple VLANs, then all those VLANs must belong to the same STP.

Overlapping VLANs Belonging to Multiple Spanning Tree Instances

The switch support the situation where a port is contained in more than one Spanning Tree instance when the port is a member of more than one VLAN and those VLANs belong to different STPs (See Figure 6).

The number of STPs that can be configured is 256.

Figure 6: Port membership of VLANs which belong to different spanning tree instances



Port 2 is a member of multiple Spanning Tree Instances (STP A and STP B) because it is a member of multiple VLANs (VLAN 2 and VLAN 3).

The Ingress and Egress Rules for Layer 2 Switching

Two components of the Layer 2 switching process are the Ingress and Egress Rules. The Ingress Rules admit or discard frames based on their VLAN tagging. The Egress Rules determine for each frame whether VLAN tags are included in the Ethernet frames that are transmitted.

The Ingress Rules

All frames, tagged and untagged, received by a VLAN-aware switch must be associated with a VLAN. Each received frame is mapped to exactly one VLAN. If an incoming frame is tagged with a valid VLAN Identifier (VID) then that VID is used. If an incoming frame is untagged, or is priority tagged (a tagged frame with a VID of all zeros), then the switch uses internal VLAN association rules to determine the VLAN it belongs too. The default setting for the *Ingress Rules* is to Admit All Frames.

The possible association rules, in order of precedence, are:

- IP subnet/IPX network classification
- protocol classification
- port classification

The switch supports a subset of these VLAN association rules at any one time. The possible subsets used are:

- IP subnet, protocol and port classification
- protocol and port classification
- port classification

The Egress Rules

Once the Forwarding Process has determined which ports and transmission queues to forward a frame from, the Egress Rules for each port determine whether or not the outgoing frame is VLAN-tagged with its numerical VLAN Identifier (VID).

A port must belong to a VLAN at all times unless the port has been set as the mirror port for the switch.

A port can transmit VLAN-tagged frames for any VLAN to which the port belongs. A port can transmit untagged frames for any VLAN for which the port is configured, e.g. IP subnet-based or protocol-based, unless prevented by the port-based VLAN egress rules. A port that belongs to a port-based VLAN can transmit untagged packets for only one VLAN.

Classifier-Based Packet Filters

You can configure the switch hardware through entries in the Generic Packet Classifier, or Classifier, to copy, drop, forward, and associate QOS attributes to packets that match specified criteria.

Every packet passing through the switch is matched against a series of classification tables by the Classifier. Classify packets according to:

- Packet type
- Layer 3 protocol
- Source/destination IP address
- Destination IPX address
- Layer 4 protocol (for example: TCP/UDP/Socket number)
- Layer 4 source/destination ports
- Source/Destination MAC address
- Source VLAN

Classifier-based packet filters are numbered in the range 1 to 1024. The number of packet filters supported by the switch is determined by the amount of available space in the packet classification tables.

To add packet filters to the switch, use the command:

```
ADD SWITCH HWFILTER=filter-id CLASSIFIER=rule-id
   ACTION={COPY|DISCARD|FORWARD|COPY,DISCARD}
```

To delete one or more packet filters from the switch, use the command:

```
DELETE SWITCH HWFILTER=filter-idlist
```

To delete all classifiers from a single packet filter, use the command:

```
DELETE SWITCH HWFILTER=filter-id CLASSIFIER=ALL
```

To show packet filters, use the command:

```
SHOW SWITCH HWFILTER[=filter-idlist]
```

Dynamic Port Security

Dynamic Port Security enables dynamic MAC address learning. If a MAC address is unused for a period of time, it will be aged from the database of currently accepted MAC addresses. This enables new MAC addresses to be learned.

The RELEARN parameter defaults to OFF. In this case static MAC address learning will be used. This means that MAC addresses once learned, cannot be unlearned.

```
SHOW SWITCH PORT={port-list|ALL} INTRUSION
```

A switch port can be manually locked before it reaches the learning limit, by using the command:

```
ACTIVATE SWITCH PORT={port-list|ALL} LOCK
```

Addresses can be manually added to a port locked list up to a total of 256 MAC addresses, and the learning limit can be extended to accommodate them, by using the command:

```
    ADD SWITCH FILTER ACTION={FORWARD|DISCARD}
       DESTADDRESS=macadd PORT=port [ENTRY=entry] [LEARN]
       [VLAN={vlan-name|1..4094}]
```

Learned addresses on locked ports can be saved as part of the switch configuration, so that they will be part of the configuration after a power cycle, using the command:

```
CREATE CONFIG=filename
```

If the configuration is not saved when there is a locked list for a port, the learning process begins again after the switch is restarted. Addresses learned through dynamic MAC learning will not be added to the configuration.

MAC Address Logging

MAC Address Logging allows the user to initiate logging of the MAC addresses of equipment connected to the switch LAN interfaces, and which access the WAN interface.

This provides an auditing trail in the event of anyone hacking into the system.

If NAT is used, the layer two MAC address of the equipment needs to be logged in addition to the IP address.

You can enable and disable MAC address logging using the commands:

```
ENABLE IP ARP LOG
```

```
DISABLE IP ARP LOG
```

Changes to Proxy ARP Defaults

Proxy ARP is defined in RFC 1027. It allows hosts which do not support routing (i.e. they have no knowledge of the network structure) to determine the physical addresses of hosts on other networks. The switch intercepts ARP broadcast packets and substitutes its own physical address for that of the remote host. This only occurs if the switch has the *best* route to the remote host. By responding to the ARP request the switch ensures that all subsequent packets from the local host will be directed to the switch’s physical address and it can then forward these to the remote host.

Proxy ARP is disabled by default. To enable or disable proxy ARP on an IP interface, use one of the commands:

```
ADD IP INTERFACE=interface IPADDRESS={ipadd|DHCP}
   PROXYARP={FALSE|NO|OFF|ON|TRUE|YES} [other-options...]
```

```
SET IP INTERFACE=interface PROXYARP={FALSE|NO|OFF|ON|TRUE|
   YES} [other-options...]
```

To display details of the interfaces assigned to the IP module, including whether or not Proxy ARP is enabled on each interface, use the command:

```
SHOW IP INTERFACE
```

For more information, see the *Internet Protocol (IP)* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Dynamic Host Control Protocol for IPv6

The Dynamic Host Configuration Protocol for IPv6 (DHCP6) is used to delegate IPv6 prefixes, and to allocate IPv6 addresses. It offers stateful address autoconfiguration, and complements the stateless address autoconfiguration described in RFC 2462 "*IPv6 Stateless Address Autoconfiguration*". DHCP is particularly useful for ISPs to allocate IPv6 prefixes to customer sites. The creation and allocation of complete IPv6 addresses is then performed by IPv6 stateless address autoconfiguration.

The switch can be configured as a DHCP6 server or client. As a DHCP6 server, it can:

- **delegate *prefixes* to IPv6 subnets.** Prefixes allow a subnet to be addressed, rather than a single node. Like IPv4 addresses, a proportion of the leftmost bits of the IPv6 address can be used to indicate the subnet. IPv6 addresses can then be allocated by stateless address autoconfiguration, by manual configuration, or by using DHCP6.
- **assign *normal* and *temporary* IPv6 *addresses* to devices.** An IPv6 address is a hexadecimal string, made up from eight pairs of octets separated by colons, for example 3ffe:2::0:1. Normal addresses are renewed by the server for as long as the device requires an address. Temporary addresses are assigned for a limited time (lease time) and are usually allocated for privacy reasons, as outlined in RFC 3041 "*Privacy Extensions for Stateless Address Autoconfiguration in IPv6*".

As a DHCP6 client, the switch can request an IPv6 address or a prefix from a DHCP6 server.

Configuring DHCP6 Servers

A DHCP6 server can delegate prefixes and/or allocate IPv6 addresses.

To configure the switch as a DHCP6 server:

1. Enable IPv6 and create an IPv6 interface on the server, using the commands:

   ```
   ENABLE IPV6
   CREATE IPV6 INTERFACE=interface
   ```

2. Enable the DHCP6 module on the server, using the command:

   ```
   ENABLE DHCP6
   ```

3. Create a DHCP6 policy on the server

   Create a policy to contain the configuration information that will be given to a requesting IPv6 host, and give it a name, using the command:

   ```
   CREATE DHCP6 POLICY=policy [INHERIT=name]
   ```

4. Configure the server to delegate a prefix or range of prefixes by assigning the IPv6 prefixes to the policy and specifying a type of PD, using the command:

   ```
   CREATE DHCP6 RANGE=range POLICY=policy
      IP=ipv6address/prefix-ipv6address/prefix TYPE=PD
   ```

   Configure the server to delegate a range of addresses, by assigning a range of IPv6 addresses to the policy, using the command:

   ```
   CREATE DHCP6 RANGE=range POLICY=policy
      IP=ipv6address/prefix[-ipv6address/prefix]
      [TYPE={NORMAL|TEMP}]
   ```

5. If required, add static entries to the range, configure authentication, and add any other required configuration settings to the policy.
6. Link the policy to the required IPv6 interface, using the command:

   ```
   ADD DHCP6 INTERFACE=interface POLICY=name
   ```

Configuring DHCP6 Clients

A DHCP6 client can request an IPv6 address for one or more of its interfaces. It can also request a DHCP6 prefix over its interface to the DHCP6 server, and then apply that prefix to other interfaces.

To configure the switch as a DHCP6 client that will request an IPv6 address from a DHCP6 server:

1. Enable the IPv6 module, using the command:

   ```
   ENABLE IPV6
   ```

2. Create the required interface, using the command:

   ```
   CREATE IPV6 INTERFACE=interface
   ```

3. Configure the interface to request its IP address from DHCP6, using the command:

   ```
   ADD IPV6 INTERFACE=interface IP=DHCP
   ```

To configure the switch as a DHCP6 client that will request a prefix from a DHCP6 server, and then apply the prefix to other interfaces:

1. Enable the IPv6 module, using the command:

   ```
   ENABLE IPV6
   ```

2. Create the required interface, using the command:

   ```
   CREATE IPV6 INTERFACE=interface
   ```

3. Configure that interface to request a prefix and apply it to another interface or interfaces, using the command:

   ```
   ADD IPV6 INTERFACE=interface IP=PD
      APPINT=app-interface[,...]
   ```

   The INTERFACE parameter specifies the interface that will request the prefix from a server. The APPINT parameter specifies the interface or comma-separated list of interfaces that the switch will apply the received prefix to.

4. Turn on router advertisements to allow the switch to advertise its prefixes to the clients for stateless address autoconfiguration, using the command:

   ```
   ENABLE IPV6 ADVERTISE
   ```

For background information, examples, more information about these commands, and information about other optional settings for DHCP6, see the *Dynamic Host Configuration Protocol for IPv6 (DHCP6)* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

For general information about configuring IPv6 interfaces, see the *Internet Protocol version 6* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Setting Preference of IPv6 Dynamic Routes

This enhancement enables you to configure your own preference for the routes learned from the dynamic IPv6 routing protocol RIPv6.

To specify the preference for RIPv6, use the command:

```
SET IPV6 ROUTE PREFERENCE={DEFAULT|1..65535} PROTOCOL=RIP
```

When more than one route in the route table matches the destination address in an IPv6 packet, the route with the lowest preference value will be used to route the packet. If two or more candidate routes have the same preference, the route with the longest prefix will be used. All existing dynamically learned routes in the routing table, and new routes added subsequently, will be updated with the specified preference value. When multiple dynamic routing protocols become available for IPv6, this enhancement will give you greater control over routing decisions.

If you specify a preference of DEFAULT, the preference will revert to the default value for this protocol type.

To display information about the current IPv6 route table preferences for RIP (Figure 7), use the command:

```
SHOW IPV6 ROUTE PREFERENCE
```

Figure 7: Example output from the SHOW IPV6 ROUTE PREFERENCE command.

```
IPv6 Route Preference
----------------------------------------------------------
 Protocol                            Preference
 ---------------------------------------------------------
 RIP ............................... 100 (default)
----------------------------------------------------------
```

For more information about IPv6 and RIPv6, see the *Internet Protocol version 6* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Adding an IPv6 Host with a Link-Local IP Address

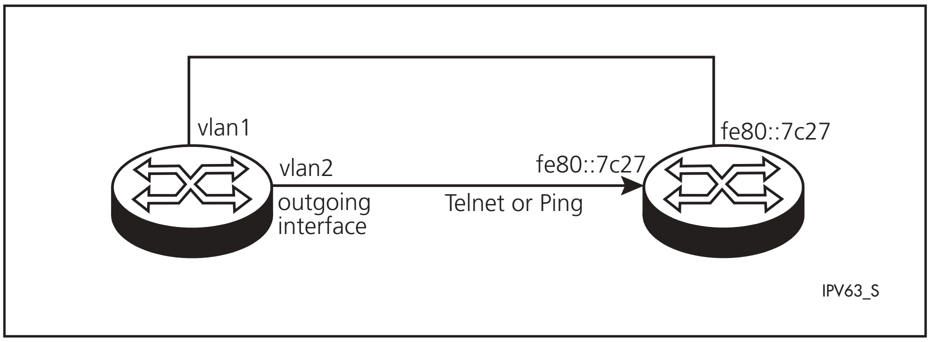
Software Release 2.6.1 enables you to specify a host name to telnet to an IPv6 link-local address. It does this by allowing you to specify the interface as well as the address. Telneting to a link-local address requires interface information as well as the address, because a single link-local address can belong to several interfaces.

To specify a host name, use the command:

```
ADD IPV6 HOST=name IPADDRESS=ipv6add [INTERFACE=interface]
```

When the IP address is a link-local address, the INTERFACE parameter lets you specify the interface out which the Telnet request is sent, as well as the address. This interface is the interface, on the switch from which the Telnet request originates, that is connected to the required destination interface (Figure 8).

Figure 8: The outgoing interface to specify when Pinging or Telneting to an IPv6 link-local address.



Network or Broadcast Addresses Not Issued by DHCP

The DHCP server will no longer issue network or broadcast addresses to clients.If a range is created to include such addresses, those addresses will be excluded from the pool of addresses available to clients.

For more information about DHCP, see the *Dynamic Host Configuration Protocol* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

DHCP Compliance with RFC 2131

DHCP policies are no longer limited to a minimum lease time of 3600 seconds. This complies with RFC 2131, *"Dynamic Host Configuration Protocol"*.

```
To create a DHCP policy, use the command:

CREATE DHCP POLICY=name LEASETIME={lease-time|INFINITY}
   [INHERIT=name]
```

where *lease-time* is a time in seconds.

> *Routers or switches that comply with RFC 1541 but not with RFC 2131 may not be able to accept a lease time of less than 3600 seconds.*

For more information about DHCP, see the *Dynamic Host Configuration Protocol* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

MIB Support for DHCP Range Exhaustion Trap

A simple DHCP range exhaustion trap has been added to the ATR enterprise MIB (atrouter.mib). The trap is triggered when a DHCP request cannot be satisfied due to range exhaustion. The gateway address and the interface address of the request are sent as trap variables. The range table shows the DHCP ranges currently defined on the DHCP server.

The DHCP Group contains objects for managing DHCP. Objects in this group have the object identifier prefix *dhcp* ({ modules 70 }). The following objects are defined:

- *dhcpRangeTable* { dhcp 1 } is a table of DHCP ranges. Each entry in the table gives information about a single DHCP range currently configured on the switch.
- *dhcpTrapVariable* { dhcp 2 } are special variables set up to act as reference points for variables sent in traps.

For more information see the *SNMP MIBs* appendix of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Changing User Account Privilege

When you change the privilege level of an existing user, you must now also specify a password for that user in the command. You can specify either the user's existing password or a new one.

To change a user's privilege level, use the command:

```
SET USER=login-name PASSWORD=password PRIVILEGE={USER|
   MANAGER|SECURITYOFFICER} [other-options...]
```

For more information about users and privilege levels, see the *Operation* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

User Authentication

The following sections summarise extensions to the switch’s functionality for authenticating users via authentication servers. For more information about user privileges, authentication, and the commands outlined in these sections, see the *Operation* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

The User Authentication Facility (UAF) supports the following methods of user authentication: an internal database called the User Authentication Database, and interrogation of external RADIUS (Remote Authentication Dial In User Service), TACACS (Terminal Access Controller Access System) or TACACS+ servers.

The UAF first queries any TACACS+ servers that have been defined. If there are no defined TACACS+ servers or all the TACACS+ servers return a reject response, the UAF will query the User Authentication Database. If the supplied login name and password does not match an entry in the User Authentication Database, the UAF sends authentication requests to any RADIUS servers that have been defined. If there are no defined RADIUS servers or all the RADIUS servers return a reject response, the UAF will send authentication requests to any TACACS servers that have been defined. If the supplied login name and password matches an entry in the User Authentication Database, or one of the defined TACACS+, RADIUS or TACACS servers returns an accept response to an authentication request, the login is accepted. If the supplied login name and password does not match an entry in the User Authentication Database, and all of the defined TACACS+, RADIUS or TACACS servers return reject responses to authentication requests, the login is rejected. The login is also rejected if Login is set to No for that user account.

TACACS+

The TACACS+ protocol is a simple TCP-based access control protocol. It improves on TACACS by:

- separating the functions of authentication, authorisation and accounting

This release of TACACS+ supports authentication and authorisation services.

- encrypting all traffic between the Network Access Server (NAS) and the daemon
- using TCP as its transport protocol for reliable delivery
- allowing for authentication exchanges of arbitrary length and content which will allow any authentication mechanism to be utilised with TACACS+ clients
- being extensible to provide for site customisation and future development features.

TACACS+ allows the authentication, authorisation and accounting services to be provided independently on separate access servers (TACACS+ servers). Each service can be tied into its own database or can use the other services available on that server or on the network.

To enable TACACS+, use the command:

```
ENABLE TACPLUS
```

To add a TACACS+ server, use the command:

```
ADD TACPLUS SERVER=ipaddress [KEY=key] [PORT=port]
   [SINGLECONNECTION=YES|NO] [TIMEOUT=1...10]
```

To enable TACACS+ debugging, use the command:

```
ENABLE TACPLUS DEBUG
```

Authorisation Services

Authorisation occurs after authentication. It is here that an *attribute value (AV) pair* is returned if configured. Attribute Value Pairs are configured on the TACACS+ server and passed onto the switch. The switch takes the appropriate action based upon the pair passed to the switch and the value of that pair. If the TACACS+ server sends an AV pair that is not supported by the switch then that attribute is ignored.

The following AV Pairs are supported:

- **Timeout**

  This value specifies the length of time that the session can exist. After this value has expired, the session will either be disconnected, or have the privilege of the user reduced. The valid timeout range is 0 to 65535 (minutes).

- **Idletime**

  If no input or output traffic is received in this time period, the session is disconnected. The valid idletime range is 0 to 65535 (minutes).

- **Privilege Level**

  The TACACS+ privilege levels supported are 1, 7, and 15, with the values mapping to USER, MANAGER, and SECOFF respectively.

S/Key

S/Key is a *one-time password* system designed to protect networks from attacks via electronic eavesdropping during user authentication. A user never logs into a server on the network using the same password more than once. Since a specific one-time password can only be used to authenticate a user once, even if the password is intercepted by a malicious user en-route to the authentication server (via a sniffer), by the time they try to gain access to the system with it, it will no longer be valid. The S/Key system generates one-time passwords by applying a one-way MD4 or MD5 hash function to the concatenation of a user-specified *seed* and secret password.

S/Key and the newer OTP system are both supported. To set the method of authentication that the switch will use, and the type of encryption, use the command:

```
SET SKEY [METHOD={SKEY|OTP}] [ENCRYPTION={MD4|MD5]
```

To calculate and display (Figure 9) one-time passwords, use the SEQUENCE and SEED parameters in the command:

```
SHOW SKEY [SEQUENCE=seq_no SEED=seed_name [NUMBER=value]]
```

where:

- *seq_no* is an integer in the range 1-9999, representing the sequence number of the last S/Key or OTP password to be generated.
- *seed_name* is the 1-16 alphanumeric user-defined string which was used to initialise the one-time password system on the authentication server.
- *value* is an integer in the range 1-99, representing the number of consecutive S/Key or OTP passwords to generate, finishing at *seq_no.*

To display the correct one-time passwords, the user must supply their current sequence number and seed. They will then be asked to enter the password, which was used when initialising their current sequence of one-time passwords on the authentication server. The entered password will not be echoed to the screen. The output will show the sequence of S/Key or OTP one-time passwords to be used for a user's subsequent login attempts.

Figure 9: Example output from the SHOW SKEY SEQ=n SEED=seed command.

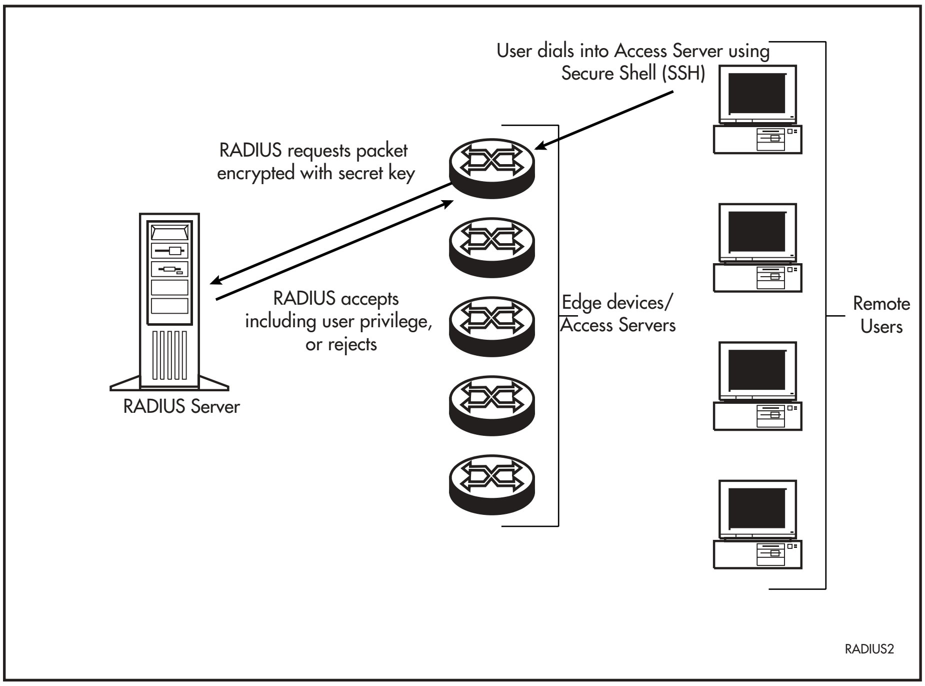
```
Enter S/KEY initialisation password :
Computing SKEY passwords using MD4....
------------------------------------------------------------
Seq No         One-Time Password
95             IT DOLT ROOM NET GLUT ROWE
96             DARE MOS SARA GOAD MAO LEO
97             GUN TAIL MEND EAT INCH JOHN
98             EARN KID CARE HELD GIRD WINE
99             ADAM WARD DECK PLY EGAN WEED
------------------------------------------------------------
```

Multiple User Privilege Levels Using RADIUS

This enhancement enables the privilege level of the user to be stored on the RADIUS server and returned with the user authentication so that the user database can be centrally administered from the RADIUS server. The user privilege level affects the commands that a user may execute. Three levels of privilege for users are supported when the switch is operating in security mode: User, Manager and Security Officer. The enhancement allows the authenticated user to log directly into a device at that user's appropriate privilege level.

The switch acts as a RADIUS client, sending requests to a RADIUS server (Figure 10). To enable the RADIUS server to authenticate users and include their privilege level, set up the server so that it returns an appropriate value in the Service-Type attribute. For Security Officer privilege, set the attribute to Administrative (6), for Manager privilege set it to NAS Prompt (7), and for User privilege set it to any other value or no value.

Figure 10: Using a Radius Server for User Authentication.


User dials into Access Server using Secure Shell (SSH)
RADIUS requests packet encrypted with secret key
RADIUS accepts including user privilege, or rejects
RADIUS Server
Edge devices/ Access Servers
Remote Users
RADIUS2

RADIUS and TACACS Debugging

This enhancement supports debugging for the RADIUS and TACACS access control protocols. Access control packet debugging allows the contents of the packets to be viewed. The debugging commands allow raw (hexadecimal dumps) and/or decoded (human-readable) packet displays.

To enable RADIUS debugging, use the command:

```
ENABLE RADIUS DEBUG={ALL|PKT|DECODE|ERROR} [,...]
```

The DEBUG parameter specifies which debugging options are to be enabled. The value may be a single option or a comma-separated list of options. If ALL is specified, all debugging options are enabled. If PKT is specified, the raw RADIUS packets are displayed. If DECODE is specified, decoded packets are displayed. If ERROR is specified, error messages regarding RADIUS transactions are displayed.

To enable TACACS debugging, use the command:

```
ENABLE TACACS DEBUG={ALL|PKT|DECODE|ERROR} [,...]
```

The DEBUG parameter specifies which debugging options are to be enabled. The value may be a single option or a comma-separated list of options. If ALL is specified, all debugging options are enabled. If PKT is specified, the raw TACACS packets are displayed. If DECODE is specified, decoded packets are displayed. If ERROR is specified, error messages regarding TACACS transactions are displayd.

Ping Polling of Device Reachability

This enhancement enables the switch to regularly check whether or not it can reach a device. It also enables a trigger to activate on the switch when the device becomes unreachable. While the device is unreachable, the switch continues to monitor the device’s reachability, and another trigger can be set to activate when the device becomes available again. For example, the first trigger’s script could open and configure an alternative link if the device at the other end of a preferred link became unavailable. The second trigger’s script would automatically return traffic to the preferred link as soon as it was available again.

To determine the device’s reachability, the switch will regularly send ICMP Echo Request packets (“pings”) to the device. As long as the switch receives ping responses from the device, it considers the device to be reachable. After the switch has not received a reply to a set number of ICMP Echo Requests, it considers the device to be unreachable. It continues to try to ping the device, at an increased rate. After it receives a set number of responses, it considers the device to be reachable again.

Configuring the switch to determine a device’s reachability and respond to changes in reachability involves the following steps:

- Create a polling instance, to periodically ping the device
- Create scripts to run when the device becomes unreachable and when it becomes reachable again
- Configure triggers to run these scripts.

To create a polling instance, use the command:

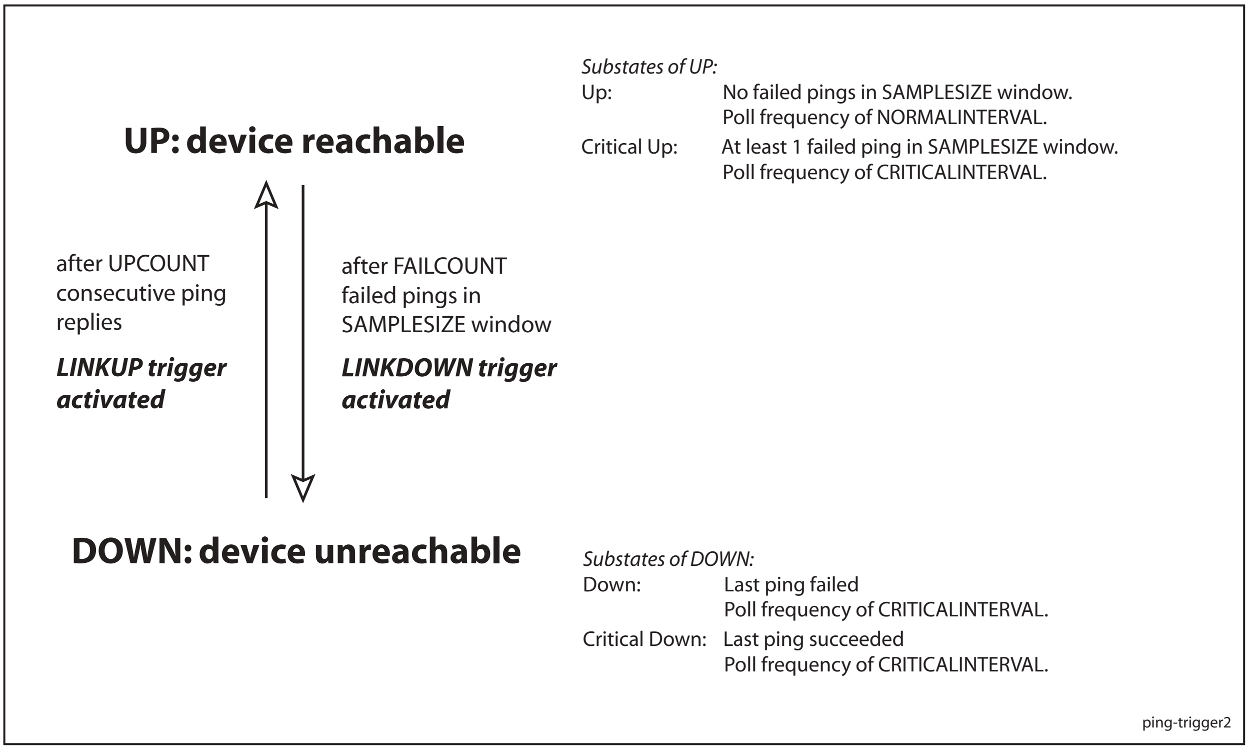
```
ADD PING POLL=poll-id IPADDRESS={ipadd|ipv6add[%interface]}
    [CRITICALINTERVAL=1..65535]
    [DESCRIPTION=poll-description] [FAILCOUNT=1..100]
    [LENGTH=4..1500] [NORMALINTERVAL=1..65535]
    [SAMPLESIZE=1..100] [SIPADDRESS={ipadd|ipv6add}]
    [TIMEOUT=1..30] [UPCOUNT=1..100]
```

where *poll-id* is a number from 1 to 100, and identifies the polling instance in the trigger commands and in other PING POLL commands. The switch can poll up to 100 IP addresses at once.

The NORMALINTERVAL parameter specifies the time period between pings when the device is reachable. By default, this is set to 30 seconds. The CRITICALINTERVAL parameter specifies the time period between pings when the switch has not received a reply to at least one ping and when the device is unreachable. The default is 1 second. The CRITICALINTERVAL enables the switch to quickly observe changes in the state of the device, and should be set to a much lower value than the NORMALINTERVAL.

The number of pings that the switch will examine to consider a change in state is controlled by three parameters: FAILCOUNT, SAMPLESIZE, and UPCOUNT. The FAILCOUNT is the number of pings that must be unanswered for the switch to consider the device unreachable. The default is 5. The SAMPLESIZE is the total number of pings within which the FAILCOUNT number of pings must be unanswered. If SAMPLESIZE and FAILCOUNT are the same, the unanswered pings must be consecutive. If SAMPLESIZE is greater than FAILCOUNT, a device that does not always reply to pings may be declared unreachable. By default, SAMPLESIZE is equal to FAILCOUNT. The UPCOUNT is the number of consecutive pings that must be answered for the switch to consider the device reachable again. The default is 30. The interaction between these parameters is shown in Figure 11.

Figure 11: The interaction between states and parameters for ping polling.


UP: device reachable
Substates of UP:
Up: No failed pings in SAMPLESIZE window. Poll frequency of NORMALINTERVAL.
Critical Up: At least 1 failed ping in SAMPLESIZE window. Poll frequency of CRITICALINTERVAL.
after UPCOUNT consecutive ping replies
LINKUP trigger activated
after FAILCOUNT failed pings in SAMPLESIZE window
LINKDOWN trigger activated
DOWN: device unreachable
Substates of DOWN:
Down: Last ping failed Poll frequency of CRITICALINTERVAL.
Critical Down: Last ping succeeded Poll frequency of CRITICALINTERVAL.
ping-trigger2

After you have configured the ping polling instance, specify a script or scripts to run when the device becomes unreachable, using the command:

```
CREATE TRIGGER=trigger-id MODULE=PING EVENT=DEVICEDOWN
   POLL=poll-id SCRIPT=filename... [other-options...]
```

Then specify a script or scripts to run when the device becomes reachable again, using the command:

```
CREATE TRIGGER=trigger-id MODULE=PING EVENT=DEVICEUP
   POLL=poll-id SCRIPT=filename... [other-options...]
```

where *filename* is the name of the script file, and will have a `.scp` extension.

Finally, enable the polling instance, using the command:

```
ENABLE PING POLL=poll-id
```

Ping polling is only available for IP and IPv6 (ICMP and ICMP6 Echo Request and Reply packets), not for IPX, AppleTalk or OSI.

For more information about these commands, see the *Ping Polling* and *Scripting* chapters of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

Ping Trigger

The Trigger Facility can be used to automatically run specified command scripts when particular triggers are activated. When a trigger is activated by an event, parameters specific to the event are passed to the script that is run. For a full description of the Trigger Facility, see the *Trigger Facility* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.

To create or modify a ping polling trigger, use the commands:

```
CREATE TRIGGER=trigger-id MODULE=PING EVENT={DEVICEDOWN|
   DEVICEUP} POLL=poll-id [AFTER=hh:mm] [BEFORE=hh:mm]
   [DATE=date|DAYS=day-list] [NAME=name] [REPEAT={YES|NO|
   ONCE|FOREVER|count}] [SCRIPT=filename...] [STATE={ENABLED|
   DISABLED}] [TEST={YES|NO|ON|OFF|TRUE|FALSE}]

SET TRIGGER=trigger-id [MODULE] [POLL=poll-id] [AFTER=hh:mm]
   [BEFORE=hh:mm] [DATE=date|DAYS=day-list] [NAME=name]
   [REPEAT={YES|NO|ONCE|FOREVER|count}] [TEST={YES|NO|ON|
   OFF|TRUE|FALSE}]
```

This section lists:

- The value you need to specify for the MODULE parameter (of the CREATE TRIGGER command), to identify ping polling
- The events you may specify in the EVENT parameter for ping polling
- The parameters you may specify as *module-specific-parameters* for ping polling
- The arguments that will be passed to the script that is activated by the trigger.

Module To identify ping polling in trigger commands use the parameter MODULE={PING|58}.

Event DEVICEDOWN

Description The ping poll specified for this trigger has determined that the polled device has become unreachable.

Parameters The following command parameter can be specified in the CREATE/SET TRIGGER commands.

Parameter	Description
POLL=*poll-id*	The ID number of the ping poll that this trigger relates to.

Script Arguments The trigger passes the following argument to the script:

Argument	Description
%1	The ID number of the ping poll that this trigger relates to.

Event DEVICEUP

Description The ping poll specified for this trigger has determined that the polled device has become reachable.

Parameters

The following command parameter can be specified in the CREATE/SET TRIGGER commands.

Parameter	Description
POLL=*poll-id*	The ID number of the ping poll that this trigger relates to.

Script Arguments

The trigger passes the following argument to the script:

Argument	Description
%1	The ID number of the ping poll that this trigger relates to.

Example

To create trigger 1 that activates whenever the ping poll with the ID of 3 determines that the polled device is unreachable, initiating the script RESPONSE.SCP, use the command:

```
CREATE TRIGGER=1 MODULE=PING EVENT=DEVICEDOWN POLL=3
   SCRIPT=RESPONSE.SCP
```

PPPoE Client Mode on a VLAN

To configure the switch as a PPPoE client, create a PPP interface over an Ethernet service, using the command:

```
CREATE PPP=ppp-interface OVER=physical-interface
   [other-ppp-options]...
```

where *ppp-interface* is the PPP interface number and *physical-interface* is the name of the physical interface in the format ETH*n-servicename*. To specify that any service name is acceptable, use the special service name ANY. Service names may be up to 18 characters in length, and are usually supplied by the ISP providing the service.

A PPPoE link cannot be multilinked to another PPPoE link, but can be multilinked to other PPP calls, using the command:

```
ADD PPP=ppp-interface OVER=physical-interface
   [other-ppp-options]...
```

SNMP Community Names - Support for all Printable ASC11 Characters

SNMP community names now support the inclusion of any printable ASCII character. Therefore, in the commands:

```
ADD SNMP COMMUNITY=name [other-options]
CREATE SNMP COMMUNITY=name [other-options]
DELETE SNMP COMMUNITY=name [other-options]
DESTROY SNMP COMMUNITY=name
DISABLE SNMP COMMUNITY=name TRAP
ENABLE SNMP COMMUNITY=name TRAP
SET SNMP COMMUNITY=name [other-options]
SHOW SNMP COMMUNITY=name
```

name is a character string, 1 to 15 characters in length. Valid characters are now any printable ASCII character. *name* is case-sensitive, so “Public” is a different name from “public”.

For more information, and the full syntax of these commands, see the *Simple Network Management Protocol (SNMP)* chapter of the *AT-8900 Series Software Reference* for Software Release 2.6.1.